**3GPP TSG-RAN WG2 #131R2-250xxxx**

**Bangalore, India, 25th – 29th Aug. 2025**

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **38.304** | **CR** | **DraftCR** | **rev** | **-** | **Current version:** | **18.4.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network | **x** | Core Network |  |

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| ***Title:*** | 38.304 Running CR for LP-WUS | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | CATT | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_LPWUS-Core | | | | |  | ***Date:*** | | | 2025-06-11 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | B |  | | | | | ***Release:*** | | |  |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)  Rel-20 (Release 20)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Introduction of LP-WUS in TS 38.304. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Introduction of LP-WUS in TS 38.304, including:  - Introduction of RRM offloading/relaxation for LP-WUS UEs.  - Introduction of LP-WUS monitoring. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | LP-WUS is not supported in NR in TS 38.304. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.2, 5.2.4.2, 5.2.4.7.0, 5.2.4.x, 7.3, 7.x, 7.y | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **x** |  | Other core specifications | | | | TS/TR 38.331 CR TBD  TS/TR 38.300 CR TBD | | |
| ***affected:*** | |  | **x** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | This is the updated version of running CR for TS 38.304 for LP-WUS considering conclusions from RAN2#130 and RAN1#121. | | | | | | | | |

Start of change

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

**2Rx XR UE**:two antenna port XR UE as specified in TS 38.101-1 [15].

**Acceptable Cell**: A cell that satisfies certain conditions as specified in 4.5.

**Allowed CAG list**: A per-PLMN list of CAG Identifiers the UE is allowed to access (see TS 23.501 [10])**.**

**Available PLMN(s)**: One or more PLMN(s) for which the UE has found at least one cell and read its PLMN identity(ies).

**Available SNPN(s)**: One or more SNPN(s) for which the UE has found at least one cell and read its SNPN identity(ies).

**Barred Cell**: A cell a UE is not allowed to camp on.

**CAG cell**: A cell broadcasting at least one Closed Access Group Identifier.

**Camped on a cell**: UE has completed the cell selection/reselection process and has chosen a cell. The UE monitors system information and (in most cases) paging information.

**Camped on any cell**: UE is in idle mode and has completed the cell selection/reselection process and has chosen a cell irrespective of PLMN identity.

**Closed Access Group Identifier**: Identifier of a CAG within a PLMN.

**Commercial Mobile Alert System**: Public Warning System that delivers *Warning Notifications* provided by *Warning Notification Providers* to CMAS capable UEs.

**Earth-fixed cell:** An NTN cell fixed with respect to a certain geographic area on the earth all the time. It can be provisioned by beam(s) continuously covering the same geographical areas all the time (e.g., the case of GSO satellites).

**Earth-moving cell**: An NTN cell moving on the ground. It can be provisioned by beam(s) whose coverage area slides over the Earth surface (e.g., the case of NGSO satellites generating fixed or non-steerable beams).

**eCall Only Mode**: A UE configuration option that allows the UE to register at 5GC and register in IMS to perform only eCall Over IMS, and a non-emergencyIMS call for test and/or terminal reconfiguration services.

**EHPLMN**:Any of the PLMN entries contained in the Equivalent HPLMN list TS 23.122 [9].

**Equivalent PLMN list**:List of PLMNs considered as equivalent by the UE for cell selection, cell reselection, and handover according to the information provided by the NAS.

**Equivalent SNPN list**:List of SNPNs considered as equivalent by the UE for cell selection, cell reselection, and handover according to the information provided by the NAS.

**eRedCap UE**:A UE with enhanced reduced capabilities as specified in clause 4.2.22 in TS 38.306 [24].

**Home PLMN**: A PLMN where the Mobile Country Code (MCC) and Mobile Network Code (MNC) of the PLMN identity are the same as the MCC and MNC of the IMSI.

**HSDN cell**: A cell that has higher priority than other cells for cell reselection for HSDN capable UE in a High-mobility state.

**Mobile-IAB cell**: As defined in TS 38.300 [2].

**Network Identifier**: Identifier of an SNPN in combination with a PLMN ID (TS 23.501 [10]).

**Non-Public Network**: A network deployed for non-public use, as defined in TS 22.261 [12].

**Non-terrestrial network**: An NG-RAN consisting of gNBs, which provides non-terrestrial NR access to UEs by means of an NTN payload embarked on an airborne or space-borne NTN vehicle and an NTN Gateway.

**NR sidelink communication**: AS functionality enabling at least V2X Communication as defined in TS 23.287 [16] and/or A2X Communication as defined in TS 23.256 [26], and ProSe communication (including ProSe non-Relay, UE-to-Network Relay communication and, UE-to-UE Relay communication including UE-to-UE Relay communication with integrated discovery) as defined in TS 23.304 [22], between two or more nearby UEs, using NR technology but not traversing any network node.

**NR sidelink discovery**: AS functionality enabling ProSe non-Relay Discovery, ProSe UE-to-Network Relay discovery and ProSe UE-to-UE Relay discovery for Proximity based Services as defined in TS 23.304 [22] between two or more nearby UEs, using NR technology but not traversing any network node.

**Process**: A local action in the UE invoked by an RRC procedure or an RRC\_IDLE or RRC\_INACTIVE state procedure.

**Quasi-Earth fixed cell**: An NTN cell fixed with respect to a certain geographic area on the earth during a certain time duration. It can be provisioned by beam(s) covering one geographic area for a limited period and a different geographic area during another period (e.g., the case of NGSO satellites generating steerable beams).

**Radio Access Technology**: Type of technology used for radio access, for instance NR or E-UTRA.

**Ranging/Sidelink Positioning**: AS functionality enabling ranging-based services and sidelink positioning as defined in TS 23.586 [25].

**RedCap UE:** A UE with reduced capabilities as specified in clause 4.2.21 in TS 38.306 [24].

**Registration Area**: (NAS) registration area is an area in which the UE may roam without a need to perform location registration, which is a NAS procedure.

**Registered PLMN**: This is the PLMN on which certain Location Registration outcomes have occurred, as specified in TS 23.122 [9].

**Registered SNPN**: This is the SNPN on which certain Location Registration outcomes have occurred, as specified in TS 23.122 [9].

**Reserved Cell**: A cell on which camping is not allowed, except for particular UEs, if so indicated in the system information.

**Selected PLMN**: This is the PLMN that has been selected by the NAS, either manually or automatically.

**Selected SNPN**: This is the SNPN that has been selected by the NAS, either manually or automatically.

**Serving cell**: The cell on which the UE is camped.

**Sidelink**: UE to UE interface for V2X sidelink communication defined in TS 23.287[16].

**SNPN Access Mode**: Mode of operation wherein UE only selects SNPNs (as defined in TS 23.501 [10]).

**SNPN identity**: An identifier of an SNPN comprising of a PLMN ID and an NID combination.

**Strongest cell**: The cell on a particular frequency that is considered strongest according to the layer 1 cell search procedure (TS 38.213 [4], TS 38.215 [11]).

**Suitable Cell**: This is a cell on which a UE may camp. For NR cell, the criteria are defined in clause 4.5, for E-UTRA cell in TS 36.304 [7].

**U2N Relay UE**: a UE that provides functionality to support connectivity to the network for U2N Remote UE(s).

**U2N Remote UE**: a UE that communicates with the network via a U2N Relay UE.

**U2U Relay UE**: a UE that provides functionality to support connectivity for U2U Remote UE(s).

**U2U Remote UE**: a UE that communicates with other UE(s) via a U2U Relay UE.

**V2X sidelink communication**: AS functionality enabling V2X Communication as defined in TS 23.285 [17], between nearby UEs, using E-UTRA technology but not traversing any network node.

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

AS Access Stratum

ATG Air To Ground

CAG Closed Access Group

CAG-ID Closed Access Group Identifier

CMAS Commercial Mobile Alert System

CN Core Network

DCI Downlink Control Information

DRX Discontinuous Reception

DTX Discontinuous Transmission

eDRX Extended DRX

ETWS Earthquake and Tsunami Warning System

E-UTRA Evolved UMTS Terrestrial Radio Access

E-UTRAN Evolved UMTS Terrestrial Radio Access Network

GIN Group ID for Network selection

H-SFN Hyper System Frame Number

HRNN Human-Readable Network Name

HSDN High Speed Dedicated Network

IAB Integrated Access and Backhaul

IMSI International Mobile Subscriber Identity

L2 Layer-2

LO LP-WUS Occasion

LP-WUS Low Power-Wake Up Signal

LR Low Power-Wake Up Receiver

MBS Multicast/Broadcast Services

MBS FSAI MBS Frequency Selection Area Identity

MCC Mobile Country Code

MCCH MBS Control Channel

MICO Mobile Initiated Connection Only

MR Main Radio

MRB MBS Radio Bearer

MTCH MBS Traffic Channel

NAS Non-Access Stratum

NCR Network-Controlled Repeater

NCR-Fwd NCR Forwarding

NCR-MT NCR Mobile Termination

NES Network Energy Savings

NID Network Identifier

NPN Non-Public Network

NR NR Radio Access

NSAG Network Slice AS Group

NTN Non-Terrestrial Network

PEI Paging Early Indication

PEI-O Paging Early Indication-Occasion

PH Paging Hyperframe

PLMN Public Land Mobile Network

PTW Paging Time Window

RAT Radio Access Technology

RNA RAN-based Notification Area

RNAU RAN-based Notification Area Update

RRC Radio Resource Control

SDT Small Data Transmission

SL Sidelink

SNPN Stand-alone Non-Public Network

TN Terrestrial Network

TRS Tracking Reference Signal

U2N UE-to-Network

U2U UE-to-UE

UAC Unified Access Control

UE User Equipment

UMTS Universal Mobile Telecommunications System

VSAT Very Small Aperture Terminal

V2X Vehicle to Everything

Next change

## 5.2 Cell selection and reselection

### 5.2.1 Introduction

UE shall perform measurements for cell selection and reselection purposes as specified in TS 38.133 [8].

When evaluating Srxlev and Squal of non-serving cells for reselection evaluation purposes, the UE shall use parameters provided by the serving cell and for the final check on cell selection criterion, the UE shall use parameters provided by the target cell for cell reselection.

The NAS can control the RAT(s) in which the cell selection should be performed, for instance by indicating RAT(s) associated with the selected PLMN, and by maintaining a list of forbidden registration area(s) and a list of equivalent PLMNs. The UE shall select a suitable cell based on RRC\_IDLE or RRC\_INACTIVE state measurements and cell selection criteria.

In order to expedite the cell selection process, stored information for several RATs, if available, may be used by the UE.

When camped on a cell, the UE shall regularly search for a better cell according to the cell reselection criteria. If a better cell is found, that cell is selected. The change of cell may imply a change of RAT. Details on performance requirements for cell reselection can be found in TS 38.133 [8].

For NCRs, if the NCR-MT in RRC\_INACTIVE (re)selects a cell other than the last serving cell on which side control configuration was received, then the NCR-MT shall indicate to NCR-Fwd to cease forwarding. If the NCR-MT in RRC\_INACTIVE detects no suitable cell, then the NCR-MT shall indicate to NCR-Fwd to cease forwarding.

The NAS is informed if the cell selection and reselection result in changes in the received system information relevant for NAS.

For normal service, the UE shall camp on a suitable cell, monitor control channel(s) of that cell so that the UE can:

- receive system information from the PLMN or SNPN; and

- receive registration area information from the PLMN or SNPN, e.g., tracking area information; and

- receive other AS and NAS Information; and

- if registered:

- receive paging and notification messages from the PLMN or SNPN; and

- initiate transfer to Connected mode.

For cell selection in multi-beam operations, measurement quantity of a cell is up to UE implementation.

For cell reselection in multi-beam operations, including inter-RAT reselection from E-UTRA to NR, the measurement quantity of this cell is derived amongst the beams corresponding to the same cell based on SS/PBCH block as follows:

- if *nrofSS-BlocksToAverage* (*maxRS-IndexCellQual* in E-UTRA) is not configured in *SIB2/SIB4* (*SIB24* in E-UTRA); or

- if *absThreshSS-BlocksConsolidation* (*threshRS-Index* in E-UTRA)is not configured in *SIB2/SIB4* (*SIB24* in E-UTRA); or

- if the highest beam measurement quantity value is below or equal to *absThreshSS-BlocksConsolidation* (*threshRS-Index* in E-UTRA):

- derive a cell measurement quantity as the highest beam measurement quantity value, where each beam measurement quantity is described in TS 38.215 [11].

- else:

- derive a cell measurement quantity as the linear average of the power values of up to *nrofSS-BlocksToAverage* (*maxRS-IndexCellQual* in E-UTRA) of highest beam measurement quantity values above *absThreshSS-BlocksConsolidation* (*threshRS-Index* in E-UTRA).

NOTE: If both suitable cell(s) and suitable L2 U2N Relay UE(s) (as specified in TS 38.331 [3]) are available, it is up to L2 U2N Remote UE's implementation to select either a suitable cell or a suitable L2 U2N Relay UE.

### 5.2.2 States and state transitions in RRC\_IDLE state and RRC\_INACTIVE state

Figure 5.2.2-1 shows the states and state transitions and procedures in RRC\_IDLE and RRC\_INACTIVE. Whenever a new PLMN selection or new SNPN selection is performed, it causes an exit to number 1.



Figure 5.2.2-1: RRC\_IDLE and RRC\_INACTIVE Cell Selection and Reselection

### 5.2.3 Cell Selection process

#### 5.2.3.1 Description

Cell selection is performed by one of the following two procedures:

a) Initial cell selection (no prior knowledge of which RF channels are NR frequencies):

1. The UE shall scan all RF channels in the NR bands according to its capabilities to find a suitable cell.

2. On each frequency, the UE need only search for the strongest cell, except for operation with shared spectrum channel access where the UE may search for the next strongest cell(s).

3. Once a suitable cell is found, this cell shall be selected.

b) Cell selection by leveraging stored information:

1. This procedure requires stored information of frequencies and optionally also information on cell parameters from previously received measurement control information elements or from previously detected cells.

2. Once the UE has found a suitable cell, the UE shall select it.

3. If no suitable cell is found, the initial cell selection procedure in a) shall be started.

NOTE: Priorities between different frequencies or RATs provided to the UE by system information or dedicated signalling are not used in the cell selection process.

#### 5.2.3.2 Cell Selection Criterion

The cell selection criterion S is fulfilled when:

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| --- |
| Srxlev > 0 AND Squal > 0 |

where:

|  |
| --- |
| Srxlev = Qrxlevmeas – (Qrxlevmin + Qrxlevminoffset )– Pcompensation - Qoffsettemp  Squal = Qqualmeas – (Qqualmin + Qqualminoffset) - Qoffsettemp |

where:

|  |  |
| --- | --- |
| Srxlev | Cell selection RX level value (dB) |
| Squal | Cell selection quality value (dB) |
| Qoffsettemp | Offset temporarily applied to a cell as specified in TS 38.331 [3] (dB) |
| Qrxlevmeas | Measured cell RX level value (RSRP) |
| Qqualmeas | Measured cell quality value (RSRQ) |
| Qrxlevmin | Minimum required RX level in the cell (dBm). If the UE supports SUL frequency for this cell, Qrxlevmin is obtained from *q-RxLevMinSUL*, if present,in *SIB1*, *SIB2* and *SIB4*, additionally, if QrxlevminoffsetcellSUL is present in *SIB3* and *SIB4* for the concerned cell, this cell specific offset is added to the corresponding Qrxlevmin to achieve the required minimum RX level in the concerned cell;  else Qrxlevmin is obtained from *q-RxLevMin* in *SIB1, SIB2* and *SIB4*, additionally, if Qrxlevminoffsetcell is present in *SIB3* and *SIB4* for the concerned cell, this cell specific offset is added to the corresponding Qrxlevmin to achieve the required minimum RX level in the concerned cell. |
| Qqualmin | Minimum required quality level in the cell (dB). Additionally, if Qqualminoffsetcell is signalled for the concerned cell, this cell specific offset is added to achieve the required minimum quality level in the concerned cell. |
| Qrxlevminoffset | Offset to the signalled Qrxlevmin taken into account in the Srxlev evaluation as a result of a periodic search for a higher priority PLMN while camped normally in a VPLMN, as specified in TS 23.122 [9]. |
| Qqualminoffset | Offset to the signalled Qqualmin taken into account in the Squal evaluation as a result of a periodic search for a higher priority PLMN while camped normally in a VPLMN, as specified in TS 23.122 [9]. |
| Pcompensation | For FR1, if the UE supports the *additionalPmax* in the *NR-NS-PmaxList*, if present, in *SIB1, SIB2* and *SIB4:*  *max(PEMAX1 –PPowerClass, 0) – (min(PEMAX2, PPowerClass) – min(PEMAX1, PPowerClass)) (dB);*  *else:*  *max(PEMAX1 –PPowerClass, 0) (dB)*  For FR2, Pcompensation is set to 0.  For IAB-MT, Pcompensation is set to 0. |
| PEMAX1, PEMAX2 | Maximum TX power level of a UE may use when transmitting on the uplink in the cell (dBm) defined as PEMAX in TS 38.101 [15]. If UE supports SUL frequency for this cell, PEMAX1 and PEMAX2 are obtained from the *p-Max* for SUL in *SIB1* and *NR-NS-PmaxList* for SUL respectively in *SIB1, SIB2* and *SIB4* as specified in TS 38.331 [3], else PEMAX1 and PEMAX2 are obtained from the *p-Max* and *NR-NS-PmaxList* respectively in *SIB1*, *SIB2* and *SIB4* for normal UL as specified in TS 38.331 [3]. |
| PPowerClass | Maximum RF output power of the UE (dBm) according to the UE power class as defined in TS 38.101-1 [15]. |

The signalled values Qrxlevminoffset and Qqualminoffset are only applied when a cell is evaluated for cell selection as a result of a periodic search for a higher priority PLMN while camped normally in a VPLMN (TS 23.122 [9]). During this periodic search for higher priority PLMN, the UE may check the S criteria of a cell using parameter values stored from a different cell of this higher priority PLMN.

#### 5.2.3.3 E-UTRAN case in Cell Selection

The cell selection criteria and procedures in E-UTRAN are specified in TS 36.304 [7].

### 5.2.4 Cell Reselection evaluation process

#### 5.2.4.1 Reselection priorities handling

Absolute priorities of different NR frequencies or inter-RAT frequencies may be provided to the UE in the system information, in the *RRCRelease* message, or by inheriting from another RAT at inter-RAT cell (re)selection. In the case of system information, an NR frequency or inter-RAT frequency may be listed without providing a priority (i.e. the field *cellReselectionPriority* is absent for that frequency). If any fields with *cellReselectionPriority* or *nsag-CellReselectionPriority* are provided in dedicated signalling, the UE shall ignore any fields with *cellReselectionPriority* and *nsag-CellReselectionPriority* provided in system information.

When UE is in camped normally state, if it supports slice-based cell reselection and has received the network slice(s) and NSAG information from NAS to be used for cell reselection, UE shall derive reselection priorities according to clause 5.2.4.11.

NOTE 00: UE derives reselection priorities according to clause 5.2.4.11 also in case *SIB16* (see TS 38.331 [3]) is not broadcast in the camped cell.

If UE is in *camped on any cell* state, UE shall only apply the priorities provided by system information from current cell, and the UE preserves priorities provided by dedicated signalling and *deprioritisationReq* received in *RRCRelease* unless specified otherwise. When the UE in camped normally state, has only dedicated priorities other than for the current frequency, the UE shall consider the current frequency to be the lowest priority frequency (i.e. lower than any of the network configured values). When the HSDN capable UE is in High-mobility state, the UE shall always consider the HSDN cells to be the highest priority (i.e., higher than any other network configured priorities). When the HSDN capable UE is not in High-mobility state, the UE shall always consider HSDN cells to be the lowest priority (i.e., lower than any other network configured priorities). If the UE is configured to perform both NR sidelink communication and V2X sidelink communication, the UE may consider the frequency providing both NR sidelink communication configuration and V2X sidelink communication configuration to be the highest priority. If the UE is configured to perform NR sidelink communication and not perform V2X communication, the UE may consider the frequency providing NR sidelink communication configuration to be the highest priority. If the UE is configured to perform V2X sidelink communication and not perform NR sidelink communication, the UE may consider the frequency providing V2X sidelink communication configuration to be the highest priority. If the UE is configured to perform ranging/sidelink positioning, the UE may consider the frequency providing ranging/sidelink positioning configuration to be the highest priority.

A UE on a vehicle with a mobile-IAB cell may consider the frequency for which a mobile-IAB cell is the best cell to be the highest priority. The UE identifies a mobile-IAB cell by *mobileIAB-Cell* in SIB1 (see TS 38.331 [3]). The UE may narrow its search scope for mobile-IAB cell(s) by *mobileIAB-CellList* if broadcasted in SIB4 (see TS 38.331 [3]). A non-mobile-IAB cell may be excluded from this mobile IAB frequency prioritization for up to 300 seconds.

NOTE 0a: The frequency only providing the anchor frequency configuration should not be prioritized for V2X service during cell reselection, as specified in TS 38.331[3].

NOTE 0b: When UE is configured to perform NR sidelink communication or V2X sidelink communication performs cell reselection, it may consider the frequencies providing the intra-carrier and inter-carrier configuration have equal priority in cell reselection.

NOTE 0c: The prioritization among the frequencies which UE considers to be the highest priority frequency is left to UE implementation unless otherwise stated.

NOTE 0d: The UE is configured to perform V2X sidelink communication or NR sidelink communication, if it has the capability and is authorized for the corresponding sidelink operation.

NOTE 0e: When UE is configured to perform both NR sidelink communication and V2X sidelink communication, but cannot find a frequency which can provide both NR sidelink communication configuration and V2X sidelink communication configuration, UE may consider the frequency providing either NR sidelink communication configuration or V2X sidelink communication configuration to be the highest priority.

NOTE 0f: Void.

NOTE 0g: How the UE determines itself to be on a vehicle with a mobile-IAB cell is left to the UE's implementation.

The UE shall only perform cell reselection evaluation for NR frequencies and inter-RAT frequencies that are given in system information and for which the UE has a priority provided.

If the MBS broadcast capable UE is receiving or interested to receive an MBS broadcast service(s) and can only receive this MBS broadcast service(s) by camping on a frequency on which it is provided, the UE may consider that frequency to be the highest priority during the MBS broadcast session as specified in TS 38.300 [2] as long as the two following conditions are fulfilled:

1) SIB1 scheduling information of the cell reselected by the UE due to frequency prioritization for MBS contains SIB20;

2) Either:

- One or more MBS FSAI(s) of that frequency is indicated in SIB21 of the serving cell and the same MBS FSAI(s) is also indicated for this MBS broadcast service in MBS User Service Description (USD) as specified in TS 26.517 [20], or

- SIB21 is not provided in the serving cell and that frequency is included in the USD of this service, or

- SIB21 is provided in the serving cell but does not provide the frequency mapping for the concerned service, and that frequency is included in the USD of this service.

NOTE 0g: It is up to UE implementation which frequency to select, when the USD provides multiple frequencies for the service the UE is interested in.

If the MBS broadcast capable UE is receiving or interested to receive an MBS broadcast service, the UE may consider cell reselection candidate frequencies at which it cannot receive the MBS broadcast service to be of the lowest priority during the MBS broadcast session as specified in TS 38.300 [2], as long as SIB1 scheduling information of the cell contains SIB20 on the MBS frequency which the UE monitors and as long as the condition 2) above is fulfilled for the serving cell.

NOTE 0h: Example scenarios in which such down-prioritisation may be needed include the cases where camping is not possible for the UE on the MBS broadcast frequency (e.g. the MBS broadcast frequency belongs to a PLMN different from UE's registered PLMN) while the UE can receive the MBS broadcast service when camped on another frequency than the MBS broadcast frequency or current frequency.

NOTE 0i: The frequency prioritization for MBS broadcast, NR sidelink communication, or V2X sidelink communication may override the re-selection priorities for slice-based cell reselection.

In case UE receives *RRCRelease* with *deprioritisationReq*, UE shall consider current frequency and stored frequencies due to the previously received *RRCRelease* with *deprioritisationReq* or all the frequencies of NR to be the lowest priority frequency (i.e. lower than any of the network configured values) while T325 is running irrespective of camped RAT. The UE shall delete the stored deprioritisation request(s) when a PLMN selection or SNPN selection is performed on request by NAS (TS 23.122 [9]).

NOTE 1: UE should search for a higher priority layer for cell reselection as soon as possible after the change of priority. The minimum related performance requirements specified in TS 38.133 [8] are still applicable.

NOTE 1a: The UE does not consider MBS broadcast, NR sidelink communication or V2X sidelink communication functionality to replace cell reselection priorities caused by HSDN or *deprioritisationReq* functionality.

The UE shall delete priorities provided by dedicated signalling when:

- the UE enters a different RRC state; or

- the optional validity time of dedicated priorities (T320) expires; or

- the UE receives an *RRCRelease* message with the field *cellReselectionPriorities* absent; or

- a PLMN selection or SNPN selection is performed on request by NAS (TS 23.122 [9]).

NOTE 2: Equal priorities between RATs are not supported.

The UE shall not consider any exclude-listed cells as candidate for cell reselection.

The UE shall consider only the allow-listed cells, if configured, as candidates for cell reselection.

NCR-MT may be configured with additional allowed cell list and/or forbidden cell list, see TS 38.300 [2]. The NCR-MT shall consider only the allowed cell list, if configured by OAM as candidates for cell reselection (ignore above exclude-listed cells and/or allow-listed cells). The NCR-MT shall not consider the cells for cell reselection in the forbidden cell list, if configured by OAM.

The UE in RRC\_IDLE state shall inherit the priorities provided by dedicated signalling and the remaining validity time (i.e. T320 in NR and E-UTRA), if configured, at inter-RAT cell (re)selection.

NOTE 3: The network may assign dedicated cell reselection priorities for frequencies not configured by system information.

#### 5.2.4.2 Measurement rules for cell re-selection

Following rules are used by the UE to limit needed measurements:

- If the serving cell fulfils Srxlev> SIntraSearchP and Squal > SIntraSearchQ:

- If *distanceThresh* and *referenceLocation* are broadcasted in *SIB19*, and if UE supports location-based measurement initiation for NTN (quasi-)Earth-fixed cell and has obtained its location information:

- If the distance between UE and the serving cell reference location *referenceLocation* is shorter than *distanceThresh*, the UE may not perform intra-frequency measurements;

- Else, the UE shall perform intra-frequency measurements;

- else if *distanceThresh* and *movingReferenceLocation* are broadcasted in *SIB19*, and if UE supports location-based measurement initiation for NTN Earth-moving cell and has obtained its location information:

- if the distance between UE's location and the serving cell reference location determined based on *movingReferenceLocation* is shorter than *distanceThresh*, the UE may not perform intra-frequency measurements;

- else, the UE shall perform intra-frequency measurements;

- Else, the UE may not perform intra-frequency measurements;

- Else, the UE shall perform intra-frequency measurements.

- The UE shall apply the following rules for NR inter-frequencies and inter-RAT frequencies which are indicated in system information and for which the UE has priority provided as defined in 5.2.4.1:

- For a NR inter-frequency or inter-RAT frequency with a reselection priority higher than the reselection priority of the current NR frequency, the UE shall perform measurements of higher priority NR inter-frequency or inter-RAT frequencies according to TS 38.133 [8].

- For a NR inter-frequency with an equal or lower reselection priority than the reselection priority of the current NR frequency and for inter-RAT frequency with lower reselection priority than the reselection priority of the current NR frequency:

- If the serving cell fulfils Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ:

- If *distanceThresh* and *referenceLocation* are broadcasted in *SIB19*, and if UE supports location-based measurement initiation for NTN (quasi-)Earth-fixed cell and has obtained its UE location information:

- If the distance between UE and the serving cell reference location *referenceLocation* is shorter than *distanceThresh*, the UE may choose not to perform measurements of NR inter-frequency cells of equal or lower priority, or inter-RAT frequency cells of lower priority;

- Else, the UE shall perform measurements of NR inter-frequency cells of equal or lower priority, or inter-RAT frequency cells of lower priority according to TS 38.133 [8];

- else if *distanceThresh* and *movingReferenceLocation* are broadcasted in *SIB19*, and if UE supports location-based measurement initiation for NTN Earth-moving cell and has obtained its location information:

- if the distance between UE's location and the serving cell reference location determined based on *movingReferenceLocation* is shorter than *distanceThresh*, the UE may not perform measurements of NR inter-frequency cells of equal or lower priority, or inter-RAT frequency cells of lower priority;

- else, the UE shall perform measurements of NR inter-frequency cells of equal or lower priority, or inter-RAT frequency cells of lower priority according to TS 38.133 [8];

- Else, the UE may choose not to perform measurements of NR inter-frequency cells of equal or lower priority, or inter-RAT frequency cells of lower priority;

- Else,the UE shall perform measurements of NR inter-frequency cells of equal or lower priority, or inter-RAT frequency cells of lower priority according to TS 38.133 [8].

- If the UE supports relaxed measurement and *relaxedMeasurement* is present in *SIB2*, the UE may further relax the needed measurements, as specified in clause 5.2.4.9.

- LP-WUS UE may further perform relaxed serving cell and neighbouring cell measurement on MR as specified in clause 5.2.4.x.1 or serving cell measurement offloading from MR to LR as specified in clause 5.2.4.x.3.

Editor’s NOTE: FFS on the terminology LP-WUS UE.

- For UE camping on NTN cell, if the UE supports skipping TN measurement, and the UE has obtained its location information, and if *coverageAreaInfoList* and *tn-AreaIdList* are broadcast in system information, the UE may not perform measurements of a TN frequency when UE is not in the coverage of that frequency provided via *tn-AreaIdList*, regardless of the frequency priority.

If the *t-Service* of the serving cell is present in *SIB19*, and if UE supports time-based measurement initiation, the UE shall perform intra-frequency, inter-frequency or inter-RAT measurements before the *t-Service*, regardless of the distance between UE and the serving cell reference location or whether the serving cell fulfils Srxlev > SIntraSearchP and Squal > SIntraSearchQ, or Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, The exact time to start measurement before *t-Service* is up to UE implementation. UE shall perform measurements of higher priority NR inter-frequency or inter-RAT frequencies according to TS 38.133 [8] regardless of the remaining service time of the serving cell (i.e. time remaining until *t-Service*).

NOTE 1: When evaluating the distance between UE and the serving cell reference location, it is up to UE implementation to obtain UE location information.

NOTE 2: In the Earth-moving cell, it is up to UE implementation to maintain a valid serving cell reference location, which is derived based on the serving satellite ephemeris, *epochTime* and *movingReferenceLocation*.

#### 5.2.4.3 Mobility states of a UE

##### 5.2.4.3.0 Introduction

The UE mobility state is determined if the parameters (TCRmax, NCR\_H, NCR\_M, TCRmaxHyst and *cellEquivalentSize*) are broadcasted in system information for the serving cell.

**State detection criteria:**

Normal-mobility state criteria:

- If number of cell reselections during time period TCRmax is less than NCR\_M.

Medium-mobility state criteria:

- If number of cell reselections during time period TCRmax is greater than or equal to NCR\_M but less than or equal to NCR\_H.

High-mobility state criteria:

- If number of cell reselections during time period TCRmax is greater than NCR\_H.

The UE shall not consider consecutive reselections where a cell is reselected again right after one reselection for mobility state detection criteria. If the UE is capable of HSDN and the *cellEquivalentSize* is configured, the UE counts the number of cell reselections for this cell as *cellEquivalentSize* configured for this cell.

**State transitions:**

The UE shall:

- if the criteria for High-mobility state is detected:

- enter High-mobility state.

- else if the criteria for Medium-mobility state is detected:

- enter Medium-mobility state.

- else if criteria for either Medium- or High-mobility state is not detected during time period TCRmaxHys**t**:

- enter Normal-mobility state.

If the UE is in High- or Medium-mobility state, the UE shall apply the speed dependent scaling rules as defined in clause 5.2.4.3.1.

##### 5.2.4.3.1 Scaling rules

UE shall apply the following scaling rules:

- If neither Medium- nor High-mobility state is detected:

- no scaling is applied.

- If High-mobility state is detected:

- Add the *sf-High* of "Speed dependent ScalingFactor for Qhyst" to Qhyst if broadcasted in system information;

- For NR cells, multiply TreselectionNR by the *sf-High* of "Speed dependent ScalingFactor for TreselectionNR" if broadcasted in system information;

- For EUTRA cells, multiply TreselectionEUTRA by the *sf-High* of "Speed dependent ScalingFactor for TreselectionEUTRA" if broadcasted in system information.

- If Medium-mobility state is detected:

- Add the *sf-Medium* of "Speed dependent ScalingFactor for Qhyst" to Qhyst if broadcasted in system information;

- For NR cells, multiply TreselectionNR by the *sf-Medium* of "Speed dependent ScalingFactor for TreselectionNR" if broadcasted in system information;

- For EUTRA cells, multiply TreselectionEUTRA by the *sf-Medium* of "Speed dependent ScalingFactor for TreselectionEUTRA" if broadcasted in system information.

In case scaling is applied to any TreselectionRAT parameter, the UE shall round up the result after all scalings to the nearest second.

#### 5.2.4.4 Cells with cell reservations, access restrictions or unsuitable for normal camping

For the highest ranked cell (including serving cell) according to cell reselection criteria specified in clause 5.2.4.6, for the best cell according to absolute priority reselection criteria specified in clause 5.2.4.5, the UE shall check if the access is restricted according to the rules in clause 5.3.1.

If that cell and other cells have to be excluded from the candidate list, as stated in clause 5.3.1, the UE shall not consider these as candidates for cell reselection. This limitation shall be removed when the highest ranked cell changes.

If the highest ranked cell or best cell according to absolute priority reselection rules is an intra-frequency or inter-frequency cell which is not suitable due to one or more of the following reasons:

- this cell belongs to a PLMN which is not indicated as being equivalent to the registered PLMN, or

- this cell is a CAG cell that belongs to a PLMN which is equivalent to the registered PLMN but with no CAG-ID that is present in the UE's allowed CAG list being broadcasted, or

- this cell is not a CAG cell and the CAG-only indication in the UE is set, or

- this cell does not belong to a SNPN that is equal to or indicated as being equivalent to the registered or selected SNPN of the UE in SNPN access mode,

the UE shall not consider this cell and, for operation in licensed spectrum, other cells on the same frequency as candidates for reselection for a maximum of 300 seconds.

For operation with shared spectrum channel access, when the highest ranked cell or best cell is not a candidate for reselection per the previous paragraph, the UE should continue to consider other cells on the same frequency for cell reselection, however if the second highest ranked cell on this frequency is also not suitable due to one or more of the above reasons, the UE may consider this frequency to be the lowest priority for a maximum of 300 seconds.

If the highest ranked cell or best cell according to absolute priority reselection rules is an intra-frequency or inter-frequency cell which is not suitable due to being part of the "list of 5GS forbidden TAs for roaming", the UE shall not consider this cell and other cells on the same frequency as candidates for reselection for a maximum of 300 seconds.

If the highest ranked cell or best cell according to absolute priority reselection rules is an inter-RAT cell which is not suitable due to being part of the "list of forbidden TAs for roaming" or belonging to a PLMN which is not indicated as being equivalent to the registered PLMN, the UE shall not consider this cell and other cells on the same frequency, as candidates for reselection for a maximum of 300 seconds.

If the UE enters into state *any cell selection*, any limitation shall be removed. If the UE is redirected under NR control to a frequency for which the timer is running, the limitation(s) on that frequency shall be removed.

#### 5.2.4.5 NR Inter-frequency and inter-RAT Cell Reselection criteria

If *threshServingLowQ* is broadcast in system information and more than 1 second has elapsed since the UE camped on the current serving cell, cell reselection to a cell on a higher priority NR frequency or inter-RAT frequency than the serving frequency shall be performed if:

- A cell of a higher priority NR or EUTRAN RAT/frequency fulfils Squal > ThreshX, HighQ during a time interval TreselectionRAT

Otherwise, cell reselection to a cell on a higher priority NR frequency or inter-RAT frequency than the serving frequency shall be performed if:

- A cell of a higher priority RAT/ frequency fulfils Srxlev > ThreshX, HighP during a time interval TreselectionRAT; and

- More than 1 second has elapsed since the UE camped on the current serving cell.

Cell reselection to a cell on an equal priority NR frequency shall be based on ranking for intra-frequency cell reselection as defined in clause 5.2.4.6.

If *threshServingLowQ* is broadcast in system information and more than 1 second has elapsed since the UE camped on the current serving cell, cell reselection to a cell on a lower priority NR frequency or inter-RAT frequency than the serving frequency shall be performed if:

- The serving cell fulfils Squal < ThreshServing, LowQ and a cell of a lower priority NR or E-UTRAN RAT/ frequency fulfils Squal > ThreshX, LowQ during a time interval TreselectionRAT.

Otherwise, cell reselection to a cell on a lower priority NR frequency or inter-RAT frequency than the serving frequency shall be performed if:

- The serving cell fulfils Srxlev < ThreshServing, LowP and a cell of a lower priority RAT/ frequency fulfils Srxlev > ThreshX, LowP during a time interval TreselectionRAT; and

- More than 1 second has elapsed since the UE camped on the current serving cell.

Cell reselection to a higher priority RAT/frequency shall take precedence over a lower priority RAT/frequency if multiple cells of different priorities fulfil the cell reselection criteria.

If more than one cell meets the above criteria, the UE shall reselect a cell as follows:

- If the highest-priority frequency is an NR frequency, the highest ranked cell among the cells on the highest priority frequency(ies) meeting the criteria according to clause 5.2.4.6;

- If the highest-priority frequency is from another RAT, the strongest cell among the cells on the highest priority frequency(ies) meeting the criteria of that RAT.

#### 5.2.4.7 Cell reselection parameters in system information broadcasts

##### 5.2.4.7.0 General reselection parameters

Cell reselection parameters are broadcast in system information and are read from the serving cell as follows:

**absThreshSS-BlocksConsolidation**

This specifies the minimum threshold for beams which can be used for selection of the highest ranked cells, if *rangeToBestCell* is configured, and for beams used for derivation of cell measurement quantity. The parameter in *SIB2* applies to the current serving frequency and the parameter in *SIB4* applies to the corresponding inter-frequency.

**cellReselectionPriority**

This specifies the absolute priority for NR frequency or E-UTRAN frequency.

**cellReselectionSubPriority**

This specifies the fractional priority value added to cellReselectionPriority for NR frequency or E-UTRAN frequency.

**combineRelaxedMeasCondition**

This indicates when the UE needs to fulfil both low mobility criterion and not-at-cell-edge criterion to determine whether to relax measurement requirements.

**combineRelaxedMeasCondition2**

This indicates when an (e)RedCap UE needs to fulfil both stationary criterion and not-at-cell-edge criterion to determine whether to relax measurement requirements.

**coverageAreaInfoList**

This indicates a list of TN coverage areas to assist skipping TN measurements for NTN UEs in RRC\_IDLE and RRC\_INACTIVE states.

**distanceThresh**

This indicates the distance threshold from the serving cell reference location to be used in location-based measurement initiation.

**movingReferenceLocation**

This indicates the reference location of the serving cell at a time reference, to be used in location-based measurement initiation for NTN Earth-moving cell.

**nrofSS-BlocksToAverage**

This specifies the number of beams which can be used for selection of the highest ranked cell, if *rangeToBestCell* is configured, and the number of beams used for derivation of cell measurement quantity. The parameter in *SIB2* applies to the current serving frequency and the parameter in *SIB4* applies to the corresponding inter-frequency.

**Qoffsets,n**

This specifies the offsetbetween the two cells.

**Qoffsetfrequency**

Frequency specific offset for equal priority NR frequencies.

**Qhyst**

This specifies the hysteresis value for ranking criteria.

**Qoffsettemp**

This specifies the additional offset to be used for cell selection and re-selection. It is temporarily used in case the RRC Connection Establishment fails on the cell as specified in TS 38.331 [3].

**Qqualmin**

This specifies the minimum required quality level in the cell in dB.

**Qrxlevmin**

This specifies the minimum required Rx level in the cell in dBm.

**Qrxlevminoffsetcell**

This specifies the cell specific Rx level offset in dB to Qrxlevmin.

**Qqualminoffsetcell**

This specifies the cell specific quality level offset in dB to Qqualmin.

**rangeToBestCell**

This specifies the R value range which the cells whose R value is within the range can be a candidate for the highest ranked cell. It is configured in SIB2 and used for intra-frequency and equal priority inter-frequency cell reselection and among the cells on the highest priority frequency(ies) for inter-frequency cell reselection within NR.

**referenceLocation**

This indicates the reference location of the serving cell to be used in location-based measurement initiation for NTN (quasi-)Earth-fixed cell.

**SIntraSearchP**

This specifies the Srxlev threshold (in dB) for intra-frequency measurements.

**SIntraSearchQ**

This specifies the Squal threshold (in dB) for intra-frequency measurements.

**SnonIntraSearchP**

This specifies the Srxlev threshold (in dB) for NR inter-frequency and inter-RAT measurements.

**SnonIntraSearchQ**

This specifies the Squal threshold (in dB) for NR inter-frequency and inter-RAT measurements.

**SSearchDeltaP**

This specifies the threshold (in dB) on Srxlev variation for relaxed measurement.

**SSearchDeltaP-Stationary**

This specifies the threshold (in dB) on Srxlev variation to evaluate stationary criterion for relaxed measurement.

**SSearchThresholdP**

This specifies the Srxlev threshold (in dB) for relaxed measurement.

**SSearchThresholdP2**

This specifies the Srxlev threshold (in dB) to evaluate not-at-cell-edge-criterion for relaxed measurement.

**SSearchThresholdQ**

This specifies the Squal threshold (in dB) for relaxed measurement.

**SSearchThresholdQ2**

This specifies the Squal threshold (in dB) to evaluate not-at-cell-edge-criterion for relaxed measurement.

**TreselectionRAT**

This specifies the cell reselection timer value. For each target NR frequency and for each RAT other than NR, a specific value for the cell reselection timer is defined, which is applicable when evaluating reselection within NR or towards other RAT (i.e. TreselectionRAT for NR is TreselectionNR, for E-UTRAN TreselectionEUTRA).

NOTE: TreselectionRAT is not broadcast in system information but used in reselection rules by the UE for each RAT.

**TreselectionNR**

This specifies the cell reselection timer value TreselectionRAT for NR. The parameter can be set per NR frequency as specified in TS 38.331 [3].

**TreselectionEUTRA**

This specifies the cell reselection timer value TreselectionRAT for E-UTRAN.

**ThreshX, HighP**

This specifies the Srxlev threshold (in dB) used by the UE when reselecting towards a higher priority RAT/ frequency than the current serving frequency. Each frequency of NR and E-UTRAN might have a specific threshold.

**ThreshX, HighQ**

This specifies the Squal threshold (in dB) used by the UE when reselecting towards a higher priority RAT/ frequency than the current serving frequency. Each frequency of NR and E-UTRAN might have a specific threshold.

**ThreshX, LowP**

This specifies the Srxlev threshold (in dB) used by the UE when reselecting towards a lower priority RAT/ frequency than the current serving frequency. Each frequency of NR and E-UTRAN might have a specific threshold.

**ThreshX, LowQ**

This specifies the Squal threshold (in dB) used by the UE when reselecting towards a lower priority RAT/ frequency than the current serving frequency. Each frequency of NR and E-UTRAN might have a specific threshold.

**ThreshServing, LowP**

This specifies the Srxlev threshold (in dB) used by the UE on the serving cell when reselecting towards a lower priority RAT/ frequency.

**ThreshServing, LowQ**

This specifies the Squal threshold (in dB) used by the UE on the serving cell when reselecting towards a lower priority RAT/ frequency.

**TSearchDeltaP**

This specifies the time period over which the Srxlev variation is evaluated forrelaxed measurement.

**TSearchDeltaP-Stationary**

This specifies the time period over which the Srxlev variation is evaluated for stationary criterion forrelaxed measurement.

**t-Service**

This indicates the time when an NTN cell is going to stop serving the area where it is currently covering, to be used in time-based measurement initiation.

**tn-AreaIdList**

This indicates a list of TN area identities associated with each frequency to assist skipping TN measurements for NTN UEs in RRC\_IDLE and RRC\_INACTIVE states. Each TN area identity in the list identifies a TN coverage area.

Editor’s NOTE: Will introduce new parameters for RRM measurement relaxation and offloading according to RRC specification.

#### 5.2.4.6 Intra-frequency and equal priority inter-frequency Cell Reselection criteria

The cell-ranking criterion Rs for serving cell and Rn for neighbouring cells is defined by:

|  |
| --- |
| Rs = Qmeas,s +Qhyst - Qoffsettemp  Rn = Qmeas,n -Qoffset - Qoffsettemp |

where:

|  |  |
| --- | --- |
| Qmeas | RSRP measurement quantity used in cell reselections. |
| Qoffset | For intra-frequency: Equals to Qoffsets,n, if Qoffsets,n is valid, otherwise this equals to zero.  For inter-frequency: Equals to Qoffsets,n plus Qoffsetfrequency, if Qoffsets,n is valid, otherwise this equals to Qoffsetfrequency. |
| Qoffsettemp | Offset temporarily applied to a cell as specified in TS 38.331 [3]. |

The UE shall perform ranking of all cells that fulfil the cell selection criterion S, which is defined in 5.2.3.2.

The cells shall be ranked according to the R criteria specified above by deriving Qmeas,n and Qmeas,s and calculating the R values using averaged RSRP results.

If *rangeToBestCell* is not configured, the UE shall perform cell reselection to the highest ranked cell. If this cell is found to be not-suitable, the UE shall behave according to clause 5.2.4.4.

If *rangeToBestCell* is configured*,* then the UE shall perform cell reselection to the cell with the highest number of beams above the threshold (i.e. *absThreshSS-BlocksConsolidation*) among the cells whose R value is within *rangeToBestCell* of the R value of the highest ranked cell. If there are multiple such cells, the UE shall perform cell reselection to the highest ranked cell among them. If this cell is found to be not-suitable, the UE shall behave according to clause 5.2.4.4.

In all cases, the UE shall reselect the new cell, only if the following conditions are met:

- the new cell is better than the serving cell according to the cell reselection criteria specified above during a time interval TreselectionRAT;

- more than 1 second has elapsed since the UE camped on the current serving cell.

NOTE: If *rangeToBestCell* is configured but *absThreshSS-BlocksConsolidation* is not configured on an NR frequency, the UE considers that there is one beam above the threshold for each cell on that frequency.

##### 5.2.4.7.1 Speed dependent reselection parameters

Speed dependent reselection parameters are broadcast in system information and are read from the serving cell as follows:

**TCRmax**

This specifies the duration for evaluating allowed amount of cell reselection(s).

**NCR\_M**

This specifies the maximum number of cell reselections to enter Medium-mobility state.

**NCR\_H**

This specifies the maximum number of cell reselections to enter High-mobility state.

**TCRmaxHyst**

This specifies the additional time period before the UE can enter Normal-mobility state.

**Speed dependent ScalingFactor for Qhyst**

This specifies scaling factor for Qhyst in *sf-High* for High-mobility state and *sf-Medium* for Medium-mobility state.

**Speed dependent ScalingFactor for TreselectionNR**

This specifies scaling factor for TreselectionNR in *sf-High* for High-mobility state and *sf-Medium* for Medium-mobility state.

**Speed dependent ScalingFactor for TreselectionEUTRA**

This specifies scaling factor for TreselectionEUTRA in *sf-High* for High-mobility state and *sf-Medium* for Medium-mobility state.

##### 5.2.4.7.2 Slice-based cell reselection parameters

Slice-based cell reselection parameters are broadcast in system information and are read from the serving cell as follows:

**nsag-CellReselectionPriority**

This specifies the priority for NR frequency when the given NSAG ID is used to set the frequency priority.

**nsag-CellReselectionSubPriority**

This specifies the fractional priority value added to *nsag-CellReselectionPriority* when the given NSAG ID is used to set the frequency priority.

#### 5.2.4.8 Inter-RAT Cell reselection in RRC\_INACTIVE state

For UE in the RRC\_INACTIVE state, upon cell reselection to another RAT, UE transitions from RRC\_INACTIVE to RRC\_IDLE and performs­ actions as specified in TS 38.331 [3].

#### 5.2.4.9 Relaxed measurement

##### 5.2.4.9.0 Relaxed measurement rules

When the UE is required to perform measurements of intra-frequency cells or NR inter-frequency cells or inter-RAT frequency cells according to the measurement rules in clause 5.2.4.2:

- if *lowMobilityEvaluation* is configured and *cellEdgeEvaluation* is not configured; and

- if the UE has performed normal intra-frequency, NR inter-frequency, or inter-RAT frequency measurements for at least TSearchDeltaP after (re-)selecting a new cell; and

- if the relaxed measurement criterion in clause 5.2.4.9.1 is fulfilled for a period of TSearchDeltaP:

- the UE may choose to perform relaxed measurements for intra-frequency cells, NR inter-frequency cells or inter-RAT frequency cells according to relaxation methods in clauses 4.2.2.9, 4.2.2.10, 4.2.2.11, 4.2C.2.7 and 4.2C.2.8 in TS 38.133 [8];

- if *cellEdgeEvaluation* is configured and *lowMobilityEvaluation* is not configured; and

- if the relaxed measurement criterion in clause 5.2.4.9.2 is fulfilled:

- the UE may choose to perform relaxed measurements for intra-frequency cells according to relaxation methods in clauses 4.2.2.9 and 4.2C.2.7 in TS 38.133 [8];

- if the serving cell fulfils Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ:

- the UE may choose to perform relaxed measurements for NR inter-frequency cells or inter-RAT frequency cells according to relaxation methods in clauses 4.2.2.10, 4.2.2.11 and 4.2C.2.8 in TS 38.133 [8];

- if both *lowMobilityEvaluation* and *cellEdgeEvaluation* are configured:

- if the UE has performed normal intra-frequency, NR inter-frequency, or inter-RAT frequency measurements for at least TSearchDeltaP after (re-)selecting a new cell; and

- if the relaxed measurement criterion in clause 5.2.4.9.1 is fulfilled for a period of TSearchDeltaP; and

- if the relaxed measurement criterion in clause 5.2.4.9.2 is fulfilled:

- the UE may choose to perform relaxed measurements for NR intra-frequency cells, inter-frequency cells or inter-RAT frequency cells according to relaxation methods in clauses 4.2.2.9, 4.2.2.10, 4.2.2.11, 4.2C.2.7 and 4.2C.2.8 in TS 38.133 [8];

- else:

- if the UE has performed normal intra-frequency, NR inter-frequency, or inter-RAT frequency measurements for at least TSearchDeltaP after (re-)selecting a new cell, and the relaxed measurement criterion in clause 5.2.4.9.1 is fulfilled for a period of TSearchDeltaP; or,

- if the relaxed measurement criterion in clause 5.2.4.9.2 is fulfilled:

- if *combineRelaxedMeasCondition* is not configured:

- the UE may choose to perform relaxed measurements for NR intra-frequency cells, inter-frequency cells or inter-RAT frequency cells according to relaxation methods in clauses 4.2.2.9, 4.2.2.10, 4.2.2.11, 4.2C.2.7 and 4.2C.2.8 in TS 38.133 [8];

- if the UE is an (e)RedCap UE; and

- if *stationaryMobilityEvaluation* is configured and *cellEdgeEvaluationWhileStationary* is not configured; and

- if the UE has performed normal intra-frequency, NR inter-frequency, or inter-RAT frequency measurements for at least TSearchDeltaP-Stationary after (re-)selecting a new cell; and

- if the relaxed measurement criterion in clause 5.2.4.9.3 is fulfilled for a period of TSearchDeltaP-Stationary:

- the UE may choose to perform relaxed measurements for intra-frequency cells, NR inter-frequency cells, or inter-RAT frequency cells according to relaxation methods in clauses 4.2B.2.9, 4.2B.2.10, and 4.2B.2.11 in TS 38.133 [8];

- if the UE is an (e)RedCap UE; and

- if both *stationaryMobilityEvaluation* and *cellEdgeEvaluationWhileStationary* are configured:

- if the UE has performed normal intra-frequency, NR inter-frequency, or inter-RAT frequency measurements for at least TSearchDeltaP-Stationary after (re-)selecting a new cell; and

- if the relaxed measurement criterion in clause 5.2.4.9.4 is fulfilled:

- the UE may choose to perform relaxed measurements for intra-frequency cells, NR inter-frequency cells, or inter-RAT frequency cells according to relaxation methods in clauses 4.2B.2.9, 4.2B.2.10, and 4.2B.2.11 in TS 38.133 [8];

- else:

- if *combineRelaxedMeasCondition2* is not configured:

- if the UE has performed normal intra-frequency, NR inter-frequency, or inter-RAT frequency measurements for at least TSearchDeltaP-Stationary after (re-)selecting a new cell; and

- if the relaxed measurement criterion in clause 5.2.4.9.3 is fulfilled for a period of TSearchDeltaP-Stationary:

- the UE may choose to perform relaxed measurements for intra-frequency cells, NR inter-frequency cells, or inter-RAT frequency cells according to relaxation methods in clauses 4.2B.2.9, 4.2B.2.10, and 4.2B.2.11 in TS 38.133 [8];

NOTE 1: It is up to UE implementation when to start performing relaxed measurements in RRC Idle/Inactive if multiple methods are configured.

NOTE 2: It is up to UE implementation which relaxation method to perform based on the "allowed" cases as specified in TS 38.133 [8] for RRC Idle/Inactive if multiple methods are configured.

The above relaxed measurements and no measurement are not applicable for frequencies that are included in *VarMeasIdleConfig*, if configured and for which the UE supports dual connectivity or carrier aggregation between those frequencies and the frequency of the current serving cell.

##### 5.2.4.9.1 Relaxed measurement criterion for UE with low mobility

The relaxed measurement criterion for UE with low mobility is fulfilled when:

- (SrxlevRef – Srxlev) < SSearchDeltaP,

Where:

- Srxlev = current Srxlev value of the serving cell (dB).

- SrxlevRef = reference Srxlev value of the serving cell (dB), set as follows:

- After selecting or reselecting a new cell, or

- If (Srxlev - SrxlevRef) > 0, or

- If the relaxed measurement criterion has not been met for TSearchDeltaP:

- The UE shall set the value of SrxlevRef to the current Srxlev value of the serving cell.

##### 5.2.4.9.2 Relaxed measurement criterion for UE not at cell edge

The relaxed measurement criterion for UE not at cell edge is fulfilled when:

- Srxlev > SSearchThresholdP, and,

- Squal > SSearchThresholdQ, if SSearchThresholdQ is configured,

Where:

- Srxlev = current Srxlev value of the serving cell (dB).

- Squal = current Squal value of the serving cell (dB).

##### 5.2.4.9.3 Relaxed measurement criterion for a stationary (e)RedCap UE

The relaxed measurement criterion for a stationary (e)RedCap UE is fulfilled when:

- (SrxlevRefStationary – Srxlev) < SSearchDeltaP-Stationary,

Where:

- Srxlev = current Srxlev value of the serving cell (dB).

- SrxlevRefStationary = reference Srxlev value of the serving cell (dB), set as follows:

- After selecting or reselecting a new cell, or

- If (Srxlev - SrxlevRefStationary) > 0, or

- If the relaxed measurement criterion has not been met for TSearchDeltaP-Stationary:

- The UE shall set the value of SrxlevRefStationary to the current Srxlev value of the serving cell.

##### 5.2.4.9.4 Relaxed measurement criterion for a stationary (e)RedCap UE not at cell edge

The relaxed measurement criterion for a stationary (e)RedCap UE not at cell edge is fulfilled when:

- the relaxed measurement criterion in clause 5.2.4.9.3 is fulfilled for a period of TSearchDeltaP-Stationary, and,

- Srxlev > SSearchThresholdP2, and,

- Squal > SSearchThresholdQ2, if SSearchThresholdQ2 is configured.

Where:

- Srxlev = current Srxlev value of the serving cell (dB).

- Squal = current Squal value of the serving cell (dB).

#### 5.2.4.10 Cell reselection with CAG cells

In addition to normal cell reselection, a UE may optionally use an autonomous search function to detect CAG cells on serving and non-serving frequencies. However UE shall follow the cell reselection criteria based on dedicated frequency priorities and only follow the autonomous cell search result if the result fulfils also the existing cell reselection criteria based on dedicated frequency priorities.

NOTE: Mobile-IAB cell reselection priority handling as specified in clause 5.2.4.1 is applicable for a mobile-IAB cell irrespective of whether this cell is a CAG cell or not.

#### 5.2.4.11 Reselection priorities for slice-based cell reselection

The UE derives reselection priorities for slice-based cell reselection by using:

- NAS provided NSAG information, only for NSAG(s) associated with the network slice(s) provided by NAS for cell reselection (see TS 23.501 [10], TS 24.501 [14]),

- *sliceInfoList* and/or *sliceInfoListDedicated* per frequency with *nsag-CellReselectionPriority* per NSAG, if provided in system information and/or dedicated signalling (see TS 38.331 [3]),

- *cellReselectionPriority* per frequency provided in system information and/or dedicated signalling (see TS 38.331 [3]).

The UE considers an NR frequency to support all slices of an NSAG if

- the nsag-ID and TA of the NSAG indicated for the NR frequency (see TS 38.331[3]) are included in the NSAG information provided by NAS. If *FreqPriorityListDedicatedSlicing* is configured, UE only considers the NSAG-frequency pairs indicated in *FreqPriorityListDedicatedSlicing* for slice-based cell reselection.

The UE considers a cell on an NR frequency to support all slices of an NSAG if

*-* the nsag-ID and TA of the NSAG indicated for the NR frequency in dedicated signalling but not in *SIB16* (see TS 38.331 [3]) are included in the NSAG information provided by NAS; or

*-* the nsag-ID and TA of the NSAG indicated for the NR frequency in *SIB16* (see TS 38.331 [3]) are included in the NSAG information provided by NAS; and

- the cell is either listed in the *sliceAllowedCellListNR* (if provided in the *sliceInfoList*) or the cell is not listed in the *sliceExcludedCellListNR* (if provided in the *sliceInfoList*); or

- Neither *sliceAllowedCellListNR* nor *sliceExcludedCellListNR* is configured in the *sliceInfoList*.

The UE shall derive reselection priorities for slice-based cell reselection according to the following rules:

- Frequencies that support at least one prioritized NSAG received from NAS have higher reselection priority than frequencies that support none of the NSAG(s) received from NAS.

- Frequencies that support at least one NSAG provided by NAS are prioritised in the order of the NAS-provided priority for the NSAG with highest priority supported on the frequency.

- Among the frequencies (one or multiple) that support the highest prioritised NSAG(s) with the same NAS-provided priorities, the frequencies are prioritized in the order of their highest *nsag-CellReselectionPriority* given for these NSAG(s). If no *nsag-CellReselectionPriority* is given for a NSAG at a frequency, the lowest priority value is used (i.e, lower than any of the network configured values for these frequencies).

- Frequencies that support none of the NSAG(s) provided by NAS are prioritized in the order of their *cellReselectionPriority*.

For a UE performing slice-based cell reselection, if the highest ranked cell or best cell in a frequency fulfils the inter- freqeuency cell reselection criteria (see clause 5.2.4.5) based on reselection priority for the frequency and NSAG derived according to this clause or fulfils intra-frequency and equal priority inter-frequency cell reselection criteria (see clause 5.2.4.6), but this cell does not support the NSAG according to this clause:

- if this cell supports any other NSAG(s) according to this clause, the UE shall re-derive a reselection priority for the frequency by considering the NSAG(s) supported by this cell (rather than those of the corresponding NR frequency);

- Otherwise, the UE shall re-derive a reselection priority for the frequency as if none of the NSAG(s) provided by NAS is supported.

This re-derived reselection priority is used for a maximum of 300 seconds, or until new network slice(s) and/or NSAG information are received from NAS. UE shall ensure the cell reselection criteria above are fulfilled based on the newly derived priorities.

#### 5.2.4.x Relaxed measurement and offloaded measurement for LP-WUS UE

##### 5.2.4.x.1 Relaxed measurement rules for LP-WUS UE

LP-WUS UE may choose to perform relaxed serving cell and neighbouring cell measurements on MR according to requirements specified in TS 38.133 [8] if the entry condition for measurement relaxation in clause 5.2.4.x.2 is fulfilled.

##### 5.2.4.x.2 Relaxed measurement criterion for LP-WUS UE

The entry condition for serving cell and neighbouring cell measurement relaxation on MR is fulfilled when:

- Srxlev > SLP\_WUS\_RelaxEntryThresholdP\_MR, and,

- Qrxlevmeas\_lr > QLP\_WUS\_RelaxEntryThresholdP\_LR, if QLP\_WUS\_RelaxEntryThresholdP\_LR is configured, and,

- Squal > SLP\_WUS\_RelaxEntryThresholdQ\_MR, if SLP\_WUS\_RelaxEntryThresholdQ\_MR is configured, and

- Qqualmeas\_lr > QLP\_WUS\_RelaxEntryThresholdQ\_LR, if QLP\_WUS\_RelaxEntryThresholdQ\_LR is configured,

Where:

- Srxlev = current Srxlev value of the serving cell (dB).

- Squal = current Squal value of the serving cell (dB).

- Qrxlevmeas\_lr = current measured cell RX level value of the serving cell based on LR (RSRP).

- Qqualmeas\_lr = current measured cell quality value of the serving cell based on LR (RSRQ).

Editor’s NOTE: The detailed parameters for RRM measurement relaxation for LP-WUS will be aligned with RRC specification.

Editor’s NOTE: FFS on exit condition for serving cell RRM relaxation, e.g., whether a separate exit condition other than ‘not fulfilling the entry condition’ is needed, or whether exit condition include MR and/or LR-based measurements.

Editor’s NOTE: FFS how to capture separate thresholds for different UE types (to be aligned with RRC specification).

Editor’s NOTE: FFS relaxed measurement criteria is different from LP-WUS monitoring criteria.

##### 5.2.4.x.3 Serving cell measurement offloading rules for LP-WUS UE

LP-WUS UE may choose to perform serving cell measurement offloading (i.e., serving cell measurement fully offloaded to LR and no serving cell measurement via MR is required) according to requirements specified in TS 38.133 [8] if the entry condition for serving cell measurement offloading in clause 5.2.4.x.4 is fulfilled. LP-WUS UE is not required to perform serving cell measurement offloading according to requirements specified in TS 38.133 [8] if the exit condition for serving cell measurement offloading in clause 5.2.4.x.4 is fulfilled.

##### 5.2.4.x.4 Serving cell measurement offloading criterion for LP-WUS UE

The entry condition for serving cell measurement offloading is fulfilled when:

- Srxlev > SLP\_WUS\_offloadingEntryThresholdP\_MR, and,

- Qrxlevmeas\_lr > QLP\_WUS\_offloadingEntryThresholdP\_LR, if QLP\_WUS\_offloadingxEntryThresholdP\_LR is configured, and,

- Squal > SLP\_WUS\_offloadingEntryThresholdQ\_MR, if SLP\_WUS\_offloadingEntryThresholdQ\_MR is configured, and

- Qqualmeas\_lr > QLP\_WUS\_offloadingEntryThresholdQ\_LR, if QLP\_WUS\_offloadingEntryThresholdQ\_LR is configured.

The exit condition for serving cell measurement offloading is fulfilled when:

- Qrxlevmeas\_lr < QLP\_WUS\_offloadingExitThresholdP\_LR, or,

- Qqualmeas\_lr < QLP\_WUS\_offloadingExitThresholdQ\_LR, if QLP\_WUS\_offloadingExitThresholdQ\_LR is configured.

The variables in the formula are defined as follows:

- Srxlev = current Srxlev value of the serving cell (dB).

- Squal = current Squal value of the serving cell (dB).

- Qrxlevmeas\_lr= current measured cell RX level value of the serving cell based on LR (RSRP).

- Qqualmeas \_lr = current measured cell quality value of the serving cell based on LR (RSRQ).

Editor’s NOTE: The detailed parameters for serving cell measurement offloading will be aligned with RRC specification.

Editor’s NOTE: FFS how to capture separate thresholds for different UE types (to be aligned with RRC specification).

### 5.2.5 Camped Normally state

This state is applicable for RRC\_IDLE and RRC\_INACTIVE state.

When camped normally, the UE shall perform the following tasks:

- monitor the paging channel of the cell as specified in clause 7 according to information broadcast in *SIB1*;

- monitor Short Messages transmitted with P-RNTI over DCI as specified in clause 6.5 in TS 38.331 [3];

- monitor relevant System Information as specified in TS 38.331 [3];

- perform necessary measurements for the cell reselection evaluation procedure;

- execute the cell reselection evaluation process on the following occasions/triggers:

1) UE internal triggers, so as to meet performance as specified in TS 38.133 [8];

2) When information on the BCCH used for the cell reselection evaluation procedure has been modified.

3) When the network slice(s) and/or NSAG information received from NAS changes.

### 5.2.6 Selection of cell at transition to RRC\_IDLE or RRC\_INACTIVE state

At reception of *RRCRelease* message to transition the UE to RRC\_IDLE or RRC\_INACTIVE, UE shall attempt to camp on a suitable cell according to *redirectedCarrierInfo* if included in the *RRCRelease* message. If the UE cannot find a suitable cell, the UE is allowed to camp on any suitable cell of the indicated RAT. If the *RRCRelease* message does not contain the *redirectedCarrierInfo,* UE shall attempt to select a suitable cell on an NR carrier. If no suitable cell is found according to the above, the UE shall perform cell selection using stored information in order to find a suitable cell to camp on.

When returning to RRC\_IDLE state after UE moved to RRC\_CONNECTED state from *camped on any cell* state, UE shall attempt to camp on an acceptable cell according to *redirectedCarrierInfo*, if included in the *RRCRelease* message. If the UE cannot find an acceptable cell, the UE is allowed to camp on any acceptable cell of the indicated RAT. If the *RRCRelease* message does not contain *redirectedCarrierInfo* UE shall attempt to select an acceptable cell on an NR frequency. If no acceptable cell is found according to the above, the UE not in SNPN Access Mode shall continue to search for an acceptable cell of any PLMN in state *any cell selection*. If no acceptable cell is found according to the above, the UE in SNPN access mode shall continue to search for an acceptable cell of any SNPN in state *any cell selection*.

### 5.2.7 Any Cell Selection state

This state is applicable for RRC\_IDLE and RRC\_INACTIVE state. In this state, the UE shall perform cell selection process to find a suitable cell. If the cell selection process fails to find a suitable cell after a complete scan of all RATs and all frequency bands supported by the UE, the UE not in SNPN Access Mode shall attempt to find an acceptable cell of any PLMN to camp on, trying all RATs that are supported by the UE and searching first for a high-quality cell, as defined in clause 5.1.1.2. If the cell selection process fails to find a suitable cell after a complete scan of all frequency bands supported by the UE, the UE in SNPN access mode shall attempt to find an acceptable cell of any SNPN to camp on.

The UE, which is not camped on any cell, shall stay in this state.

### 5.2.8 Camped on Any Cell state

This state is only applicable for RRC\_IDLE state. In this state, the UE shall perform the following tasks:

- monitor Short Messages transmitted with P-RNTI over DCI as specified in clause 6.5 in TS 38.331 [3];

- monitor relevant System Information as specified in TS 38.331 [3];

- perform necessary measurements for the cell reselection evaluation procedure;

- execute the cell reselection evaluation process on the following occasions/triggers:

1) UE internal triggers, so as to meet performance as specified in TS 38.133 [8];

2) When information on the BCCH used for the cell reselection evaluation procedure has been modified.

- regularly attempt to find a suitable cell trying all frequencies of all RATs that are supported by the UE. If a suitable cell is found, UE shall move to *camped normally* state.

- if the UE supports voice services, the UE is not in SNPN access mode, and the current cell does not support IMS emergency calls as indicated by the field *ims-EmergencySupport* in SIB1 as specified in TS 38.331 [3], the UE shall perform cell selection/reselection to an acceptable cell that supports emergency calls in any supported RAT regardless of priorities provided in system information from current cell, if no suitable cell is found.

- if the UE supports voice services, the UE is in SNPN access mode, and the current cell does not support IMS emergency calls for any SNPN(s) as indicated by the field *imsEmergencySupportForSNPN* in SIB1 as specified in TS 38.331 [3], the UE shall perform cell selection/reselection to an acceptable cell of any available SNPN that supports emergency calls, if no suitable cell is found.

Next change

# 7 Paging

## 7.1 Discontinuous Reception for paging

The UE may use Discontinuous Reception (DRX) in RRC\_IDLE and RRC\_INACTIVE state in order to reduce power consumption. The UE monitors one paging occasion (PO) per DRX cycle. A PO is a set of PDCCH monitoring occasions and can consist of multiple time slots (e.g. subframe or OFDM symbol) where paging DCI can be sent (TS 38.213 [4]). One Paging Frame (PF) is one Radio Frame and may contain one or multiple PO(s) or starting point of a PO. A L2 U2N Relay UE monitors the paging occasions of its PC5-RRC connected L2 U2N Remote UEs. In this case, the DRX cycle and UE ID mentioned in this clause refer to those of the L2 U2N Remote UE.

In multi-beam operations, the UE assumes that the same paging message and the same Short Message are repeated in all transmitted beams and thus the selection of the beam(s) for the reception of the paging message and Short Message is up to UE implementation. The paging message is same for both RAN initiated paging and CN initiated paging.

The UE initiates RRC Connection Resume procedure upon receiving RAN initiated paging. If the UE receives a CN initiated paging in RRC\_INACTIVE state, the UE moves to RRC\_IDLE and informs NAS. However, if a L2 U2N Relay UE in RRC\_INACTIVE state receives a CN initiated paging for a L2 U2N Remote UE, the L2 U2N Relay UE does not move to RRC\_IDLE state.

NOTE 0a: The L2 U2N Remote UE does not need to monitor the PO in order to receive the paging message.

NOTE 0b: While the SDT procedure is ongoing in RRC\_INACTIVE state, the UE monitors the PO in order to receive only the Short Message as specified in TS 38.331 [3].

The PF and PO for paging are determined by the following formulae:

SFN for the PF is determined by:

(SFN + PF\_offset) mod T = (T div N)\*(UE\_ID mod N)

Index (i\_s), indicating the index of the PO is determined by:

i\_s = floor (UE\_ID/N) mod Ns

The PDCCH monitoring occasions for paging are determined according to *pagingSearchSpace* as specified in TS 38.213 [4] and *firstPDCCH-MonitoringOccasionOfPO* and *nrofPDCCH-MonitoringOccasionPerSSB-InPO* ifconfigured as specified in TS 38.331 [3]. When *SearchSpaceId* = 0 is configured for *pagingSearchSpace*, the PDCCH monitoring occasions for paging are same as for RMSI as defined in clause 13 in TS 38.213 [4].

When *SearchSpaceId* = 0 is configured for *pagingSearchSpace*, Ns is either 1 or 2. For Ns = 1, there is only one PO which starts from the first PDCCH monitoring occasion for paging in the PF. For Ns = 2, PO is either in the first half frame (i\_s = 0) or the second half frame (i\_s = 1) of the PF.

When *SearchSpaceId* other than 0 is configured for *pagingSearchSpace,* the UE monitors the (i\_s + 1)th PO. A PO is a set of 'S\*X ' consecutive PDCCH monitoring occasions where 'S' is the number of actual transmitted SSBs determined according to *ssb-PositionsInBurst* in *SIB1* and X is the *nrofPDCCH-MonitoringOccasionPerSSB-InPO* if configured or is equal to 1 otherwise. The [x\*S+K]th PDCCH monitoring occasion for paging in the PO corresponds to the Kth transmitted SSB, where x=0,1,…,X-1, K=1,2,…,S. The PDCCH monitoring occasions for paging which do not overlap with UL symbols (determined according to *tdd-UL-DL-ConfigurationCommon*) are sequentially numbered from zero starting from the first PDCCH monitoring occasion for paging in the PF. When *firstPDCCH-MonitoringOccasionOfPO* is present, the starting PDCCH monitoring occasion number of (i\_s + 1)th PO is the (i\_s + 1)th value of the *firstPDCCH-MonitoringOccasionOfPO* parameter; otherwise, it is equal to i\_s \* S\*X. If X > 1, when the UE detects a PDCCH transmission addressed to P-RNTI within its PO, the UE is not required to monitor the subsequent PDCCH monitoring occasions for this PO.

NOTE 1: A PO associated with a PF may start in the PF or after the PF.

NOTE 2: The PDCCH monitoring occasions for a PO can span multiple radio frames. When *SearchSpaceId* other than 0 is configured for *paging-SearchSpace* the PDCCH monitoring occasions for a PO can span multiple periods of the paging search space.

The following parameters are used for the calculation of PF and i\_s above:

T: DRX cycle of the UE.

If the UE does not operate in eDRX as defined in clause 7.4:

- T is determined by the shortest of the UE specific DRX value configured by RRC (if any), the UE specific DRX value configured by upper layers (if any), and a default DRX value broadcast in system information. For L2 U2N Relay UE, T for a L2 U2N Remote UE is determined by the shortest of the UE specific DRX value provided in PC5-RRC signalling and a default DRX value broadcast in system information.

In RRC\_IDLE state, if the UE operates in eDRX and eDRX is configured by upper layers, i.e., TeDRX, CN, according to clause 7.4:

- If TeDRX, CN is no longer than 1024 radio frames:

- T = TeDRX, CN;

- else:

- During CN configured PTW, T is determined by the shortest of UE specific DRX value, if configured by upper layers, and the default DRX value broadcast in system information.

In RRC\_INACTIVE state, if the UE operates in eDRX and eDRX is configured by RRC, i.e., TeDRX, RAN (if any), and upper layers, i.e., TeDRX, CN, as defined in clause 7.4:

- If both TeDRX, CN and used TeDRX, RAN are no longer than 1024 radio frames:

- T = min{TeDRX, RAN, TeDRX, CN}.

- If TeDRX, CN is no longer than 1024 radio frames and no TeDRX, RAN is configured or used:

- T is determined by the shortest of UE specific DRX value configured by RRC and TeDRX, CN.

- If TeDRX, CN is longer than 1024 radio frames:

- If TeDRX, RAN is not configured or used:

- During CN configured PTW, T is determined by the shortest of the UE specific DRX value configured by RRC, the UE specific DRX value configured by upper layers (if any), and a default DRX value broadcast in system information. Outside the CN configured PTW, T is determined by the UE specific DRX value configured by RRC;

- else if used TeDRX, RAN is no longer than 1024 radio frames:

- During CN configured PTW, T is determined by the shortest of the UE specific DRX value, if configured by upper layers and TeDRX, RAN, and a default DRX value broadcast in system information. Outside the CN configured PTW, T is determined by TeDRX, RAN;

- else if used TeDRX, RAN is longer than 1024 radio frames:

- During the overlapped part of CN configured PTW and RAN configured PTW, T is determined by the shortest of the UE specific DRX value configured by RRC, the UE specific DRX value configured by upper layers (if any), and a default DRX value broadcast in system information;

- During CN configured PTW and outside RAN configured PTW, T is determined by the shortest of the UE specific DRX value configured by upper layers (if any), and a default DRX value broadcast in system information;

- Outside CN configured PTW and during RAN configured PTW, T is determined by the UE specific DRX value configured by RRC.

N: number of total paging frames in T

Ns: number of paging occasions for a PF

PF\_offset: offset used for PF determination

UE\_ID:

If the UE operates in eDRX as specified in clause 7.4:

- 5G-S-TMSI mod 4096

else:

- 5G-S-TMSI mod 1024

Parameters *Ns*, *nAndPagingFrameOffset*, *nrofPDCCH-MonitoringOccasionPerSSB-InPO*, and the length of default DRX Cycle are signaled in *SIB1*. The values of N and PF\_offset are derived from the parameter *nAndPagingFrameOffset* as defined in TS 38.331 [3]. The parameter *firstPDCCH-MonitoringOccasionOfPO* is signalled in *SIB1* for paging in the BWP configured by *initialDownlinkBWP*.For paging in a DL BWP other than the BWP configured by *initialDownlinkBWP*, the parameter *first-PDCCH-MonitoringOccasionOfPO* is signaled in the corresponding BWP configuration.

If the UE has no 5G-S-TMSI, for instance when the UE has not yet registered onto the network, the UE shall use as default identity UE\_ID = 0 in the PF and i\_s formulas above.

5G-S-TMSI is a 48 bit long bit string as defined in TS 23.501 [10]. 5G-S-TMSI shall in the formulae above be interpreted as a binary number where the left most bit represents the most significant bit.

In RRC\_INACTIVE state, if the UE supports *inactiveStatePO-Determination* and the network broadcasts *ranPagingInIdlePO* with value "true", the UE shall use the same i\_s as for RRC\_IDLE state. Otherwise, the UE determines the i\_s based on the parameters and formula above.

In RRC\_INACTIVE state, if used eDRX value configured by upper layers is no longer than 1024 radio frames, the UE shall use the same i\_s as for RRC\_IDLE state.

In RRC\_INACTIVE state, if used eDRX value configured by upper layers is longer than 1024 radio frames, during CN PTW, the UE shall use the same i\_s as for RRC\_IDLE state. Outside CN PTW, the UE shall use the i\_s for RRC\_INACTIVE state.

## 7.2 Paging Early Indication

### 7.2.1 Paging Early Indication reception

The UE may use Paging Early Indication (PEI) in RRC\_IDLE and RRC\_INACTIVE states in order to reduce power consumption. If PEI configuration is provided in system information, the UE in RRC\_IDLE or RRC\_INACTIVE state supporting PEI (except for the UEs expecting MBS group notification) can monitor PEI using PEI parameters in system information according to the procedure described below.

If *lastUsedCellOnly* is configured in system information of a cell, the UE monitors PEI in this cell only if the UE most recently received *RRCRelease* without *noLastCellUpdate* in this cell. Otherwise (i.e., if *lastUsedCellOnly* is not configured in system information of a cell), the UE monitors PEI in the camped cell.

The UE monitors one PEI occasion per DRX cycle. A PEI occasion (PEI-O) is a set of PDCCH monitoring occasions (MOs) and can consist of multiple time slots (e.g. subframes or OFDM symbols) where PEI can be sent (TS 38.213 [4]). In multi-beam operations, the UE assumes that the same PEI is repeated in all transmitted beams and thus the selection of the beam(s) for the reception of the PEI is up to UE implementation.

The time location of PEI-O for UE's PO is determined by a reference point and an offset:

- The reference point is the start of a reference frame determined by a frame-level offset from the start of the first PF of the PF(s) associated with the PEI-O, provided by *pei-FrameOffset* in SIB1;

- The offset is a symbol-level offset from the reference point to the start of the first PDCCH MO of this PEI-O, provided by *firstPDCCH-MonitoringOccasionOfPEI-O* in SIB1.

If one PEI-O is associated with POs of two PFs, the two PFs are consecutive PFs calculated by the parameters *PF\_offset*, *T*, *Ns*, and *N*. The first PF of the PFs associated with the PEI-O is provided by (SFN for PF) - floor (*iPO*/*Ns*)\**T*/*N*, where SFN for PF is determined in clause 7.1, *iPO* is defined in clause 10.4a in TS 38.213[4], *T*, *Ns*, and *N* are determined in clause 7.1.

The PDCCH MOs for PEI are determined as specified in TS 38.213 [4] according to *pei-SearchSpace*, *pei-FrameOffset*, *firstPDCCH-MonitoringOccasionOfPEI-O* and *nrofPDCCH-MonitoringOccasionPerSSB-InPO* ifconfigured as specified in TS 38.331 [3]. When *SearchSpaceId* = 0 is configured for *pei-SearchSpace*, the PDCCH MOs for PEI are same as for RMSI as defined in clause 13 in TS 38.213 [4]. UE determines first PDCCH MO for PEI-O based on *pei-FrameOffset* and *firstPDCCH-MonitoringOccasionOfPEI-O*, as for the case with *SearchSpaceId* > 0 configured.

When *SearchSpaceId* = 0 is configured for *pei-SearchSpace*, the UE monitors the PEI-O according to *searchSpaceZero*. When *SearchSpaceId* other than 0 is configured for *pei-SearchSpace,* the UE monitors the PEI-O according to the search space with the configured *SearchSpaceId*.

A PEI occasion is a set of 'S\*X' consecutive PDCCH MOs, where 'S' is the number of actual transmitted SSBs determined according to *ssb-PositionsInBurst* in *SIB1*, and X is the *nrofPDCCH-MonitoringOccasionPerSSB-InPO* if configured or is equal to 1 otherwise. The [x\*S+K]thPDCCH MO for PEI in the PEI-O corresponds to the Kth transmitted SSB, where x=0,1,…,X-1, K=1,2,…,S. The PDCCH MOs for PEI which do not overlap with UL symbols (determined according to *tdd-UL-DL-ConfigurationCommon*) are sequentially numbered from zero starting from the first PDCCH MO for PEI in the PEI-O. When the UE detects a PEI within its PEI-O, the UE is not required to monitor the subsequent MO(s) associated with the same PEI-O.

If the UE detects PEI and the PEI indicates the subgroup the UE belongs to monitor its associated PO, as specified in clause 10.4a in TS 38.213 [4], the UE monitors the associated PO as specified in clause 7.1. If the UE does not detect PEI on the monitored PEI occasion or the PEI does not indicate the subgroup the UE belongs to monitor its associated PO, as specified in clause 10.4a in TS 38.213 [4], the UE is not required to monitor the associated PO as specified in clause 7.1.

If the UE is unable to monitor the PEI occasion (i.e. all valid PDCCH MO for PEI) corresponding to its PO, e.g. during cell re-selection, the UE monitors the associated PO according to clause 7.1.

In RRC\_INACTIVE state, when the UE uses the same i­\_sas for RRC\_IDLE state as specified in clause 7.1, the UE shall use the same *iPO* as for RRC\_IDLE state. Otherwise, the UE determines the *iPO* based on the formula defined in clause 10.4a in TS 38.213 [4].

## 7.3 Subgrouping for PEI

### 7.3.0 General

If PEI and subgrouping are configured, UEs monitoring the same PO can be divided into one or more subgroups. With subgrouping, the UE monitors the associated PO if the corresponding bit for subgroup the UE belongs to is indicated as 1 by PEI corresponding to its PO, as specified in clause 10.4a in TS 38.213 [4].

The following parameters are used for the determination of subgroup ID:

- *subgroupsNumPerPO*: total number of subgroups for both CN assigned subgrouping (if any) and UE\_ID based subgrouping (if any) in a PO, which is broadcasted in system information;

- *subgroupsNumForUEID*: number of subgroups for UE\_ID based subgrouping in a PO, which is broadcasted in system information.

UE's subgroup can be either assigned by CN as specified in clause 7.3.1 or formed based on UE\_ID as specified in clause 7.3.2:

- If *subgroupsNumForUEID* is absent in *subgroupConfig*, the subgroup ID based on CN assigned subgrouping as specified in clause 7.3.1, if available for the UE, is used in the cell.

- If both *subgroupsNumPerPO* and *subgroupsNumForUEID* are configured, and *subgroupsNumForUEID* has the same value as *subgroupsNumPerPO*, the subgroup ID based on UE\_ID based subgrouping as specified in clause 7.3.2 is used in the cell.

- If both *subgroupsNumPerPO* and *subgroupsNumForUEID* are configured, and *subgroupsNumForUEID* < *subgroupsNumPerPO*:

- The subgroup ID based on CN assigned subgrouping as specified in clause 7.3.1, if available for the UE, is used in the cell;

- Otherwise, the subgroup ID based on UE\_ID based subgrouping as specified in clause 7.3.2 is used in the cell.

If a UE has no CN assigned subgroup ID or does not support CN assigned subgrouping, and there is no configuration for *subgroupsNumForUEID*, the UE monitors the associated PO according to clause 7.1.

### 7.3.1 CN assigned subgrouping

Paging with CN assigned subgrouping is used in the cell which supports CN assigned subgrouping, as described in clause 7.3.0. A UE supporting CN assigned subgrouping in RRC\_IDLE or RRC\_INACTIVE state can be assigned a subgroup ID (between 0 to 7) by AMF through NAS signalling. The UE belonging to the assigned subgroup ID monitors its associated PEI which indicates the paged subgroup(s) as specified in clause 7.2.

### 7.3.2 UE\_ID based subgrouping

Paging with UE\_ID based subgrouping is used in the cell which supports UE\_ID based subgrouping, as described in clause 7.3.0.

If the UE is not configured with a CN assigned subgroup ID, or if the UE configured with a CN assigned subgroup ID is in a cell supporting only UE\_ID based subgrouping, the subgroup ID of the UE is determined by the formula below:

SubgroupID = (floor(UE\_ID/(N\*Ns)) mod subgroupsNumForUEID) + (subgroupsNumPerPO - subgroupsNumForUEID),

where:

N: number of total paging frames in T, which is the DRX cycle of RRC\_IDLE state as specified in clause 7.1

Ns: number of paging occasions for a PF

UE\_ID: 5G-S-TMSI mod X, where X is 32768, if eDRX is applied; otherwise, X is 8192

subgroupsNumForUEID: number of subgroups for UE\_ID based subgrouping in a PO, which is broadcasted in system information

In RRC\_INACTIVE state with CN configured PTW the SubgroupID used outside CN PTW is the same as the SubgroupID used inside CN PTW.

The UE belonging to the SubgroupID monitors its associated PEI which indicates the paged subgroup(s) as specified in clause 7.2.

## 7.4 Paging in extended DRX

The UE may be configured by upper layers and/or RRC with an extended DRX (eDRX) cycle TeDRX, CN and/or TeDRX, RAN.

For CN paging, the UE operates in eDRX in RRC\_IDLE or RRC\_INACTIVE states if the UE is configured for eDRX by upper layers and *eDRX-AllowedIdle* is signalled in SIB1; otherwise, the UE does not operate in eDRX.

For RAN paging, the UE in RRC\_INACTIVE state:

- if the UE is configured for eDRX by *ran-ExtendedPagingCycleConfig-r18* and *eDRX-AllowedInactive-r18* is signalled in SIB1:

- operates in eDRX with an eDRX cycle TeDRX, RAN configured by *extendedPagingCycle-r18*;

- else if the UE is configured for eDRX by *ran-ExtendedPagingCycle-r17* and *eDRX-AllowedInactive-r17* is signalled in SIB1:

- operates in eDRX with an eDRX cycle TeDRX, RAN configured by *ran-ExtendedPagingCycle-r17*;

- else:

- does not operate in eDRX.

If the UE operates in eDRX with an eDRX cycle no longer than 1024 radio frames, it monitors POs as defined in 7.1 with configured eDRX cycle. Otherwise, a UE operating in eDRX monitors POs as defined in 7.1 during a periodic Paging Time Window (PTW) configured for the UE. The PTW is UE-specific and is determined by a Paging Hyperframe (PH), a starting position within the PH (PTW\_start) and an ending position (PTW\_end). PH, PTW\_start and PTW\_end are given by the following formula:

The PH for CN is the H-SFN satisfying the following equations:

H-SFN mod TeDRX, CN= (UE\_ID\_H mod TeDRX, CN), where

- TeDRX, CN: UE-specific eDRX cycle in Hyper-frames, (TeDRX, CN = 2, …, 1024 Hyper-frames) configured by upper layers.

The PH for RAN is the H-SFN satisfying the following equations:

H-SFN mod TeDRX\_RAN= (UE\_ID\_H mod TeDRX\_RAN), where

- TeDRX\_RAN: UE-specific eDRX cycle in Hyper-frames, (TeDRX\_RAN = 2, …, 1024 Hyper-frames) configured by RRC.

For CN configured PTW:

PTW\_start denotes the first radio frame of the PH for CN that is part of the PTW and has SFN satisfying the following equation:

SFN = 128 \* ieDRX, CN, where

- ieDRX, CN = floor(UE\_ID\_H /TeDRX, CN) mod 8

PTW\_end is the last radio frame of the PTW and has SFN satisfying the following equation:

SFN = (PTW\_start + L\*100 - 1) mod 1024, where

- L = Paging Time Window (PTW) length (in seconds) configured by upper layers

For RAN configured PTW:

PTW\_start denotes the first radio frame of the PH for RAN that is part of the PTW and has SFN satisfying the following equation:

SFN = 128 \* ieDRX\_CN, where

- ieDRX\_CN = floor(UE\_ID\_H /TeDRX\_CN) mod 8

PTW\_end is the last radio frame of the PTW and has SFN satisfying the following equation:

SFN = (PTW\_start + L\*100 - 1) mod 1024, where

- L = Paging Time Window (PTW) length (in seconds) configured by RRC

UE\_ID\_H is defined as follows:

UE\_ID\_H: 13 most significant bits of the Hashed ID.

Hashed ID is defined as follows:

Hashed\_ID is Frame Check Sequence (FCS) for the bits b31, b30…, b0 of 5G-S-TMSI.

5G-S-TMSI = <b47, b46, …, b0> as defined in TS 23.003 [23].

The 32-bit FCS shall be the ones complement of the sum (modulo 2) of Y1 and Y2, where

- Y1 is the remainder of xk (x31 + x30 + x29 + x28 + x27 + x26 + x25 + x24 + x23 + x22 + x21 + x20 + x19 + x18 + x17 + x16 + x15 + x14 + x13 + x12 + x11 + x10 + x9 + x8 + x7 + x6 + x5 + x4 + x3 + x2 + x1 + 1) divided (modulo 2) by the generator polynomial x32 + x26 + x23 + x22 + x16 + x12 + x11 + x10 + x8 + x7 + x5 + x4 + x2 + x + 1, where k is 32; and

- Y2 is the remainder of Y3 divided (modulo 2) by the generator polynomial x32 + x26 + x23 + x22 + x16 + x12 + x11 + x10 + x8 + x7 + x5 + x4 + x2 + x + 1, where Y3 is the product of x32 by "b31, b30…, b0 of S-TMSI or 5G-S-TMSI", i.e., Y3 is the generator polynomial x32 (b31\*x31 + b30\*x30 + … + b0\*1).

NOTE: The Y1 is 0xC704DD7B for any 5G-S-TMSI value. An example of hashed ID calculation is in Annex A.

## 7.x LP-WUS monitoring

### 7.x.0 General

The UE may monitor LP-WUS in RRC\_IDLE and RRC\_INACTIVE states in order to reduce power consumption. If LP-WUS configuration is provided in system information, the UE in RRC\_IDLE or RRC\_INACTIVE state supporting LP-WUS (except for the UEs expecting MBS group notification) may start LP-WUS monitoring using LP-WUS parameters in system information according to the procedure described below if the entry condition in clause 7.x.1 is fulfilled. The UE may stop LP-WUS monitoring if the exit condition in clause 7.x.1 is fulfilled.

If the UE detects LP-WUS and the LP-WUS is associated with the UE as specified in clause 10.xx in TS 38.213 [4], the UE monitors the associated PO as specified in clause 7.1 or monitors PEI as specified in clause 7.2, which is up to UE implementation if PEI is supported and related configuration is provided in system information. If UE does not detect a LP-WUS on the monitored LP-WUS occasion (LO) or the LP-WUS is not associated with the UE as specified in clause 10.xx in TS 38.213 [4], the UE is not required to monitor the associated PO as specified in clause 7.1.

The UE monitors one LP-WUS occasion per DRX cycle. A LO is a set of LP-WUS monitoring occasions (LP-WUS MOs). In multi-beam operations, the UE assumes that the same LP-WUS is repeated in all transmitted beams and thus the selection of the beam(s) for the reception of the LP-WUS is up to UE implementation.

The time location of an LO for UE’s PO is determined by a reference PF and the configured frame-level offset:

* The reference PF is the start of the PF, or the first PF of the PF(s) (if mapping of POs from multiple PFs to one LO is supported), associated with the LO. The reference PF for the LO of a PO is provided by (SFN for PF) – floor(*iPO*/*NS*) \* *T*/*N*, where SFN for PF is determined in clause 7.1, *iPO* is defined in clause 10.4C in TS 38.213[4], *T*, *Ns*, and *N* are determined in clause 7.1.
* The frame-level offset between the LO and the reference PF is provided by *lo-Offset* in SIB1.

If single value is configured for *lo-Offset*, and if the gap between the LO and the corresponding PO is no less than the wake-up delay that a UE supports, the UE monitors the LO associated with the offset, otherwise the UE follows the paging monitoring procedure as described in clause 7.1 or 7.2.

If more than one values are configured for *lo-Offset*, and if the gap between the LO associated with the largest offset and the corresponding PO is no less than the wake-up delay that a UE supports, the UE monitors the LO associated with the smallest offset value which is no less than the wake-up delay, otherwise the UE follows the paging monitoring procedure as described in clause 7.1 or 7.2.

Editor’s NOTE: The detailed parameters for LP-WUS monitoring will be aligned with RRC specification.

### 7.x.1 Condition for LP-WUS monitoring

The entry condition for LP-WUS monitoring is fulfilled when:

- Srxlev > SLP\_WUS\_EntryThresholdP\_MR, and,

- Qrxlevmeas\_lr > QLP\_WUS\_EntryThresholdP\_LR, if QLP\_WUS\_EntryThresholdP\_LR is configured, and,

- Squal > SLP\_WUS\_EntryThresholdQ\_MR, if SLP\_WUS\_EntryThresholdQ\_MR is configured, and

- Qqualmeas\_lr > QLP\_WUS\_EntryThresholdQ\_LR, if QLP\_WUS\_EntryThresholdQ\_LR is configured.

The exit condition for LP-WUS monitoring is fulfilled when:

- Qrxlevmeas\_lr < QLP\_WUS\_ExitThresholdP\_LR or,

- Qqualmeas\_lr < QLP\_WUS\_ExitThresholdQ\_LR, if QLP\_WUS\_ExitThresholdQ\_LR is configured.

The parameters in the formula are defined as follows:

- Srxlev = current Srxlev value of the serving cell (dB).

- Squal = current Squal value of the serving cell (dB).

- Qrxlevmeas \_lr= current measured cell RX level value of the serving cell based on LR (RSRP).

- Qqualmeas \_lr = current measured cell quality value of the serving cell based on LR (RSRQ).

- SLP\_WUS\_EntryThresholdP\_MR: The Srxlev threshold for entry condition of LP-WUS monitoring based on MR.

- SLP\_WUS\_EntryThresholdQ\_MR: The Squal threshold for entry condition of LP-WUS monitoring based on MR.

- QLP\_WUS\_EntryThresholdP\_LR: The cell RX level threshold for entry condition of LP-WUS monitoring based on LR.

- QLP\_WUS\_EntryThresholdQ\_LR: The cell quality threshold for entry condition of LP-WUS monitoring based on LR.

- QLP\_WUS\_ExitThresholdP\_LR: The cell RX level threshold for exit condition of LP-WUS monitoring based on LR.

- QLP\_WUS\_ExitThresholdQ\_LR: The cell quality threshold for exit condition of LP-WUS monitoring based on LR.

These thresholds can be configured separately for LR measurments based on LP-SS and LR measurements based on SSB if a cell supports both measurement types as specified in TS 38.331 [3]. If UE supports both measurement types, it is up to UE implementation to choose whether LR measurments are based on LP-SS or based on SSB for the determination of the LP-WUS monitoring entry/exit conditions.

Editor’s NOTE: The detailed parameters for LP-WUS monitoring conditions will be aligned with RRC specification.

## 7.y Subgrouping for LP-WUS

### 7.y.0 General

With LP-WUS monitoring, UEs monitoring the same PO can be divided into one or more subgroups.

The following parameters are used for the determination of subgroup ID for LP-WUS:

- *lp-SubgroupsNumPerPO*: total number of subgroups for both CN assigned subgrouping (if any) and UE\_ID based subgrouping (if any) for LP-WUS in a PO, which is broadcasted in system information;

- *lp-SubgroupsNumForUEID*: number of subgroups for UE\_ID based subgrouping for LP-WUS in a PO, which is broadcasted in system information.

UE's subgroup for LP-WUS can be either assigned by CN as specified in clause 7.y.1 or formed based on UE\_ID as specified in clause 7.y.2:

- If *lp-SubgroupsNumForUEID* is absent in *lp-SubgroupConfig*, the subgroup ID based on CN assigned subgrouping for LP-WUS as specified in clause 7.y.1, if available for the UE, is used in the cell.

- If both *lp-SubgroupsNumPerPO* and *lp-SubgroupsNumForUEID* are configured, and *lp-SubgroupsNumForUEID* has the same value as *lp-SubgroupsNumPerPO*, the subgroup ID based on UE\_ID based subgrouping for LP-WUS as specified in clause 7.y.2 is used in the cell.

- If both *lp-SubgroupsNumPerPO* and *lp-SubgroupsNumForUEID* are configured, and *lp-SubgroupsNumForUEID* < *lp-SubgroupsNumPerPO*:

- The subgroup ID based on CN assigned subgrouping for LP-WUS as specified in clause 7.y.1, if available for the UE, is used in the cell;

- Otherwise, the subgroup ID based on UE\_ID based subgrouping for LP-WUS as specified in clause 7.y.2 is used in the cell.

If a UE has no CN assigned subgroup ID for LP-WUS or does not support CN assigned subgrouping for LP-WUS, and there is no configuration for *lp-SubgroupsNumForUEID*, the UE monitors the associated PO according to clause 7.1 or monitors PEI as specified in clause 7.2.

Editor’s NOTE: The detailed parameters for LP-WUS subgrouping will be aligned with RRC specification.

### 7.y.1 CN assigned subgrouping for LP-WUS

LP-WUS with CN assigned subgrouping is used in the cell which supports CN assigned subgrouping for LP-WUS, as described in clause 7.y.0. A UE supporting CN assigned subgrouping for LP-WUS in RRC\_IDLE or RRC\_INACTIVE state can be assigned a subgroup ID (between 1 to 31) by AMF through NAS signalling. The UE belonging to the assigned subgroup ID monitors its associated LP-WUS as specified in clause 7.x.

### 7.y.2 UE\_ID based subgrouping for LP-WUS

LP-WUS with UE\_ID based subgrouping is used in the cell which supports UE\_ID based subgrouping for LP-WUS, as described in clause 7.y.0.

If the UE is not configured with a CN assigned subgroup ID for LP-WUS, or if the UE configured with a CN assigned subgroup ID for LP-WUS is in a cell supporting only UE\_ID based subgrouping for LP-WUS, the subgroup ID of the UE for LP-WUS is determined by the formula below:

SubgroupID = (floor(UE\_ID/(N\*Ns\*Np)) mod lp-SubgroupsNumForUEID) + (lp-SubgroupsNumPerPO – lp-SubgroupsNumForUEID),

where:

N: number of total paging frames in T, which is the DRX cycle of RRC\_IDLE state as specified in clause 7.1

Ns: number of paging occasions for a PF

Np is the number of *subgroupsNumForUEID* for PEI, if configured and UE supports PEI; otherwise, Np is 1

UE\_ID: 5G-S-TMSI mod 1048576

lp-SubgroupsNumForUEID and lp-SubgroupsNumPerPO are the subgroup number for UE\_ID based subgrouping for LP-WUS and the total subgroup number for LP-WUS, respectively

Editor’s NOTE: The detailed parameters for LP-WUS subgrouping will be aligned with RRC specification.

End of change

Annex A– RAN2 agreements

### Agreements on procedure and configuration of LP-WUS in RRC\_IDLE INACTIVE

|  |  |  |
| --- | --- | --- |
| **RAN2 agreements** | **Impacted specification** | **Comments, if any** |
| **RAN2#125bis** | | |
| * The LP-WUS related configuration for IDLE/INACTIVE state is provided via system information. FFS if dedicated configuration is needed. * Working assumption: the LP-WUS configuration in SIB at least includes the following information:   - LP-SS configuration  - LP-WUS configuration  - FFS on Entry/exit condition for LP-WUS monitoring | Wait for further progress. |  |
| * The PEI subgrouping method is taken as baseline for LP-WUS subgrouping, i.e. CN assigned and UE\_ID based subgrouping. FFS the maximum number of subgroups. | No impact. |  |
| **RAN2#126** | | |
| * RAN2 will further discuss the details about LP-WUS monitoring entry/exit conditions based on RAN1’s existing working assumptions. | No impact. |  |
| * The LP-WUS related configuration in SIB at least include the following information for IDLE/INACTIVE:   - LP-SS configuration  - LP-WUS configuration  - Entry/exit condition for LP-WUS monitoring (FFS if it always configured) | No impact. |  |
| * Baseline for entry condition definition: If the serving cell quality, e.g. RSRP, RSRQ from MR, is above threshold(s) (if configured), UE may start to monitor LP-WUS, if UE monitors LP-WUS, it may stop monitoring the legacy PO. FFS if any measurement from LR is needed. * Baseline for exit condition definition: If the serving cell measurement result based on LR is below a threshold (if configured), UE monitors PO as in legacy and it may stop monitoring the LP-WUS. | Captured in 7.x.1. |  |
| * RAN2 understand that if UE is configured with CN-based LP-WUS subgrouping, it is up to CN to assign the LP-WUS subgroup ID to the UE. | Captured in 7.y.1. |  |
| * RAN2 assume the maximum number of subgroups that can be configured for LP-WUS subgrouping is no less than 8. | No impact. |  |
| * From RAN2 perspective, no new procedure is introduced for SI reception/updates. | No impact. |  |
| **RAN2#127** | | |
| * Baseline: The network does not need to be aware of whether the UE is monitoring LP-WUS or not in RRC\_IDLE/INACTIVE | No impact. |  |
| * Separate entry/exit thresholds can be configured for OFDM-based and OOK-based WUR if a cell supports both types of LRs. Signalling details are FFS. | Captured in 7.x.1 with Eiditor Notes. |  |
| * Working assumption (can revisit if R1/R4 reached different conclusions): If the entry/exit conditions are configured, besides MR-based thresholds, LP-WUS monitoring entry condition can also include LR-based thresholds. * The metrics for serving cell quality measured by MR/LR for entry condition includes (LP-)RSRP and optional (LP-)RSRQ. * The metrics for serving cell quality measured by LR for exit condition includes (LP-)RSRP and optional (LP-)RSRQ. | Captured in 7.x.1. |  |
| **RAN2#127bis** | | |
| * If NW configure thresholds for both MR and LR measurements, then the entry condition is met when all the measured results are above the configured threshold(s). * The LPWUS monitoring exit condition does not include MR measurements. | Captured in 7.x.1. |  |
| * For CN assigned LP-WUS subgrouping, RAN2 assumes similar procedure for PEI will be used for LP-WUS subgrouping. Final design is up to SA2/CT1/RAN3 discussion. * For UE\_ID based subgrouping, similar formula defined for PEI subgrouping is reused for LP-WUS subgrouping. * RAN2 inform this conclusion to SA2/CT1/RAN3.   This LS is approved in R2-2409225 | Captured in 7.y. |  |
| **RAN2#128** | | |
| * FFS whether/how to handle the case for UE-ID based subgrouping when the UE has an emergency PDU session. * FFS on the following options   - Option 1: The subgrouping number for UE\_ID based PEI subgrouping is considered in the formula for UE\_ID based LP-WUS subgrouping.  - Option 2 The subgrouping number for UE\_ID LPWUS subgrouping includes an offset K which is configurable or fixed.  - Option 3: The formula for UE\_ID based PEI subgrouping is reused. | No impact. |  |
| * We will use the following to draft the LS. The LS is not CC to RP. * The LS is approved (unseen) in R2-2410957. | No impact. |  |
| **RAN2#129** | | |
| On separate band issue   * RAN2 understands that UE can report which band(s) is supported by LR to NW. * RAN2 understands that any potential overload issues could be addressed by current mechanism in spec. * Send LS to RAN1 and RAN4 to inform the agreements. | No impact. |  |
| On sub-grouping   * For UE\_ID based subgrouping, similar formula defined for PEI subgrouping is reused for LP-WUS subgrouping, i.e.,   **SubgroupID = (floor (UE\_ID/(N\*Ns\*Np)) mod subgroupsNumForUEID) + (subgroupsNumPerPO – subgroupsNumForUEID), where**  **- UE\_ID is related to 5G-S-TMSI,**  **- N is the number of total paging frames in one DRX cycle,**  **- Ns is the number of the PO for a PF,**  **- Np is the number of subgroupNumForUEID for PEI, if configured and UE supports PEI; otherwise, Np is 1,**  - subgroupsNumForUEID and subgroupsNumPerPO are the subgroup number for UE\_ID based subgrouping for LP-WUS and the total subgroup number for LP-WUS, respectively. | Captured in 7.y.2. |  |
| On SA2 LS (R2-2500050/S2-2412876)   * RAN2 sends reply LS to SA2/RAN3/CT1, and CC RAN1 and RAN4 to confirm the “LP-WUS” terminology. * Regarding the SA2 raised issue on UE Radio Capability for Paging Information, R2 understand that there is no issue for NW after Release 17 (in which case the LP-WUS UE-ID based subgrouping UE capability is included in the UE-RadioPagingInfo container). Whether there is issue for the other cases (for the features mentioned by SA2 LS R2-2500050) can be further discussed in the main session. | No impact |  |
| **RAN2#129bis** | | |
| * LP-WUS is supported with eDRX, FFS on exact impact if any | Wait for further progress. |  |
| * Use 5G-S-TMSI to determine the UE\_ID in the formula of UE\_ID based subgrouping for LP-WUS, i.e., UE\_ID=5G-S-TMSI mod X. * X is based on 32 subgrouping number. Details can be discussed in the running CR. * Send LS to RAN3 (CC SA2/SA3) to inform our agreements on UE ID based subgrouping. * Correct the typo as following for the previous agreed formula of UE\_ID based subgrouping for LP-WUS:   + - * + Np is the number of subgroupsNumForUEID for PEI, if configured and UE supports PEI; otherwise, Np is 1. |  |  |
| * Confirm the principle for determining CN assigned subgrouping or UE\_ID based subgrouping for PEI is reused for LP-WUS subgrouping. Details will be discussed in the running CR. | Captured in 7.y |  |
| * All the LP-WUS related configurations except for measurement configurations are provided in SIB1. FFS the details on measurement configurations. * Dedicated configuration in RRC signaling is not needed for providing LP-WUS related configuration in RRC\_IDLE/INACTIVE modes. | No impact |  |
| * Use existing Srxlev/Squal for all MR measurement based entry/exit condition evaluation. * Use measured value for all LR measurement based entry/exit condition evaluation. | Captured in 5.2.4.9.x, 5.2.4.9.z and 7.x.1. |  |
| **RAN2#130** | | |
| * For UE\_ID based subgrouping , X is 1048576, i.e., the largest UE ID range in all LP\_WUS cases is be used for all LP-WUS monitoring cases. | Captured in 7.y.2. |  |
| * UEs expecting MBS group notification should monitor its PO to receive the MBS group notification regardless of LP-WUS. | Captured in 7.x.0. |  |
| On open issues for TS38.331   * RRM relaxation / offloading configuration is provided in SIB2. * RAN2 assumes the design of UAI reporting for preferred time offset is same as the legacy, e.g. including the configuration, procedure, as well as prohibit timer, etc.   On LP-WUS in MR-DC   * LP-WUS, if supported by UE, can only be configured to be monitored on the PCell, if the MN is a gNB (i.e. for NE-DC and NR-DC) and/or with LP-WUS to be monitored on the PSCell, if the SN is a gNB (i.e. for EN-DC, NGEN-DC and NR-DC).   On UE capabilities   * A UE indicating support of LP-WUS reception in IDLE/INACTIVE shall support UE-ID based subgrouping. * From R2 point of view, RRM measurement relaxation and RRM measurement fully offloading are defined as RAN2 capability without UE capability signalling. * UE supporting LP-WUS reception shall also support RRM measurement relaxation and RRM measurement fully offloading | No impact |  |
| * The entry/exit condition for LP-WUS monitoring is mandatory in LP-WUS configuration, if the LP-WUS configuration is provided by the NW. * Full coverage for LP-WUS is not precluded, e.g., if there needs to be a threshold value so that the condition is always fulfilled for all LPWUS UEs. | No impact. |  |
| * It is up to UE implementation to choose whether SSB measurement based or OOK LP-SS measurement based conditions are used for LP-WUS monitoring entry/exit condition, if UE support both measurement types. | Specified in 7.x.1. |  |
| * RAN2 aim at supporting enabling/disabling LP-WUS monitoring in IDLE/INACTVE per UE, if the solution can be concluded in the August meeting. | Wait for further progress. |  |
|  |  |  |
|  |  |  |

### Agreements on RRM measurement relaxation and offloading in RRC\_IDLE/INACTIVE

|  |  |  |
| --- | --- | --- |
| **RAN2 agreements** | **Impacted specification** | **Comments, if any** |
| **RAN2#125bis** | | |
| N/A |  |  |
| **RAN2#126** | | |
| * For serving cell measurement offloading (i.e., serving cell measurement fully offloaded to LR and no serving cell measurement via MR is required), RAN2 should focus on specifying the offloading criterion for serving cell for UEs supporting LP-WUS, and assume that RAN4 will define the measurement offloading requirements for serving cell. | Wait for further progress. |  |
| * RAN2 understand that the RRM measurement of the neighboring cell can only be performed by MR. Can discuss again if RAN1 inform us otherwise. * RAN2 will further discuss the neighbor cell measurement relaxation criteria (if the UE is using LR to measure the serving cell), e.g., considering reuse Rel-16 criteria for ‘not at cell edge’ and ‘low mobility’. | No impact. |  |
| RAN2#127 | | |
| * RAN2 only discuss RRM measurement offloading/relaxation for LP-WUS UEs. | Captured in 5.2.4.x. |  |
| * For serving cell measurement offloading (i.e., there is no serving cell measurement by MR):   + - The entry conditions for serving cell measurement offloading can be defined as at least MR greater than a certain RSRP threshold, and LR could also be considered.     - The exit condition is based on the LR measurement results. | Captured in 5.2.4.x. |  |
| RAN2#127bis | | |
| Working assumption   * For neighbor cell measurement relaxation for UEs capable of LP-WUS, do not define additional MR-based criterion over the R16 criteria. RAN2 assume ‘UE not at cell edge’ is reused, FFS on ‘UE with low mobility’. * FFS (if needed) on enhancements based on R16 criteria (e.g., based on the LR measurements) for the case when MR serving cell measurement results are not available. | Wait for further progress |  |
| RAN2#128 | | |
| * The entry condition for serving cell RRM relaxation is at least ‘if serving cell quality measured by MR is higher than relaxation threshold, e.g. RSRP and/or RSRQ’. FFS if LR measurement is needed. * FFS on exit condition for serving cell RRM relaxation, e.g., whether a separate exit condition other than ‘not fulfilling the entry condition’ is needed, or whether exit condition include MR and/or LR-based measurements * FFS if the entry condition for serving cell RRM measurement relaxation is the same as neighbour cell RRM measurement relaxation. | Wait for further progress |  |
| RAN2#129 | | |
| * The entry condition for MR serving cell RRM relaxation can include both MR and LR measurements. * If LR threshold is configured, the entry condition is when both MR and LR measurement are above the configured thresholds. | Captured in 5.2.4.x. |  |
| RAN2#129bis | | |
| * RAN2 assumes for the entry/ exit conditions of serving cell measurement offloading and serving cell RRM measurement relaxation: separate MR thresholds (according to RAN1 agreement)/LR thresholds can be configured for different types of LP WUR if a cell supports both types of LRs (can revisit based on RAN1 and RAN 4 progress, if any). | FFS |  |
| * RAN2 assumes the entry/exit thresholds for RRM relaxation/offloading for OFDM-based WUR measuring LP-SS only are the same as that for OOK-based WUR measuring LP-SS. It can be revisited based on RAN1/RAN4 process, if any. Network is allowed to provide either OOK based threshold or OFDM based WUR mesasuring SSB threhold or both. * It is up to NW to configure either serving cell relaxation or serving cell offloading or both in one cell. | No impact. |  |
| * The metrics for RRM measurement offloading/relaxation criteria include (LP-)RSRP and optional (LP-)RSRQ. * How to define LP-RSRP and LP-RSRQ is up to RAN1. | Captured in 5.2.4.x. |  |
| * The duplication between RAN2 and RAN4 specification on RRM relaxation and offloading should be avoided, details up to running CR rapporteur and companies’ review. | No impact. |  |
| * Merge the entry/exit condition for Serving Cell RRM measurement relaxation and Rel-19 Neighboring Cell RRM measurement relaxation (higher priority frequency is separate discussion). | Captured in 5.2.4.2 and 5.2.4.x. |  |
| **RAN2#130** | | |
| * The corresponding threshold(s) of entry condition for serving cell RRM offloading should be higher than the threshold(s) of entry condition for R19 RRM relaxation (serving cell relaxation and neighboring cell relaxation), if there is such configuration. Capture this in the field description. Details will be discussed in the running CR. * It is up to NW to configure the condition for LP-WUS monitoring and/or [R19 serving/ neighboring cell RRM relaxation /R19 serving cell RRM offloading], as in the current RRC running CR. * The threshold of the MR based entry condition for serving cell RRM offloading should be higher than or equal to the threshold to stop neighboring cell RRM measurement, which is the maximum of {SIntraSearchP, SnonIntraSearchP}. Capture this in the field description. Details will be discussed in the running CR. | No impact. |  |
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Annex B– RAN1 agreements (only RAN2 relevant part on LP-WUS operation in IDLE/INACTIVE modes)

### Agreements on LP-WUS operation in IDLE/INACTIVE modes

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| --- | --- | --- |
| **RAN1 agreements** | **Impacted specification** | **Comments, if any** |
| **RAN1#116** | | |
| **Agreement**  For the case where a UE supports PEI and PEI is configured by the gNB, after the UE receives LP-WUS indicating wake-up, it is up to UE implementation whether to monitor PEI or not. | Captured in 7.x.0 |  |
| **Agreement**  It is supported that the UE monitors the legacy PO after receiving LP-WUS indicating wake-up.   * FFS: support of UE monitoring dynamic PO | Captured in 7.x.0 |  |
| **RAN1#116bis** | | |
| **Agreement**  For multi-beam operation of LP-WUS, UE assumes the same LP-WUS information payload is repeated in all transmitted beams corresponding to LP-WUS   * the selection of the beam(s) for the reception of the LP-WUS is up to UE implementation | Wait for further progress |  |
| **Agreement**  Each LO consists of N \* K LP-WUS MOs, where N is the number of beams corresponding to LP-WUS, and K is the number of LP-WUS MOs for each beam.   * Option 1: K = 1 * Option 2: K can be larger than or equal to 1   + FFS if more than 1 LP-WUS is transmitted from the same beam, whether the information in these multiple LP-WUS is always the same or can be different | Wait for further progress |  |
| **RAN1#117** | | |
| N/A |  |  |
| **RAN1#118** | | |
| **Agreement**  At least support 1:1 association between LP-WUS MO(s)/LP-SS transmissions and SSB beams. | Wait for further progress |  |
| **RAN1#118bis** | | |
| **Agreement**  Confirm the following working assumption for iDRX: For each UE, the periodicity of LO is the same as its iDRX cycle. | Captured in 7.x.0 |  |
| **Agreement**  From RAN1 perspective, when a UE is monitoring LP-WUS (based on the entry/exit condition for LP-WUS), a UE is not required to monitor a PO if   * it does not detect a LP-WUS on the monitored LO * or the LP-WUS does not indicate a wake-up indication for the UE’s corresponding subgroup | Captured in 7.x.0 |  |
| **Agreement**  Each LP-WUS is QCLed with one SSB. Each LP-SS is QCLed with one SSB.   * FFS QCL Type A or Type C and/or Type D * FFS implicit QCL determination or some signaling is required   **Agreement**  The number of beams for LP-SS is the same as the number of beams for the LP-WUS MOs in an LO. | Wait for further progress |  |
| **Agreement**  For the offset value(s) between an LO and a reference PO/PF, consider the following options:   * Definition: The gap between an LO and a PO is considered to be no less than the wake-up delay a UE supports if the gap between the end of the last LP-WUS MO the UE monitors in the LO and the start of the PO is no less than the wake-up delay. * Option 1: gNB configures a single offset value.   + If the gap between an LO and the PO associated with the offset is no less than the wake-up delay a UE supports, the UE monitors the PO associated with the offset after receiving a wake-up indication in a LP-WUS.   + Otherwise,     - Option 1-1: the UE follows the legacy paging monitoring procedure.     - Option 1-2: the UE monitors LP-WUS. If it receives a wake-up indication in a LP-WUS, it monitors the first PO after its reported wake-up delay. * Option 2: gNB configures one or multiple offset values.   + For the same PO, each offset corresponds to a LO.     - This does not preclude the possibility that the same LO may correspond to different POs with different offset values.   + Option 2A: A UE does not expect that the gap between the LO associated with the largest offset and the corresponding PO is less than the wake-up delay the UE supports. The UE monitors the LO associated with one offset that has a gap between the LO and the corresponding PO no less than the wake-up delay.     - This implies that the gNB needs to configure at least one offset value that is no less than the largest wake-up delay supported by the UEs.     - FFS exactly how to choose the offset   + Option 2B:     - If the gap between the LO associated with the largest offset and the corresponding PO is no less than the wake-up delay a UE supports, the UE monitors the LO associated with one offset that has a gap between the LO and the PO associated with the offset no less than the wake-up delay.       * FFS exactly how to choose the offset     - Otherwise,       * Option 2B-1: the UE follows the legacy paging monitoring procedure.       * Option 2B-2: the UE monitors LP-WUS. If it receives a wake-up indication in a LP-WUS, it monitors the first PO after its reported wake-up delay.         + FFS exactly how to choose the offset   + FFS the UE shall monitor the LO associated with additional offset(s)   Note: The PO mentioned above refers to legacy PO configured for the UE. | Wait for further progress |  |
| **Agreement**  When K (K>1) LP-WUS MOs are configured for each beam in an LO, down select between   * Option A: K LP-WUS MOs for a beam are divided into M (M >=1) groups of R LP-WUS MOs. A UE monitors all or some of the MO(s) within the K LP-WUS MOs.   For each group of R LP-WUS MOs, the same LP-WUS information is transmitted.   * + - FFS how the same LP-WUS information is transmitted in the R LP-WUS MOs   Different LP-WUS information can be transmitted in different groups of R LP-WUS MOs.  M = 1 and M > 1 is supported.  FFS: detailed UE monitoring behavior  FFS R=1 or R>= 1   * Option B: K LP-WUS MOs for a beam are divided into G (G >= 1) groups of R\*M (M >= 1) LP-WUS MOs. A UE monitors all or some of the MO(s) within one group of R\*M LP-WUS MOs based on its subgroup ID.   Each group of R\*M LP-WUS MOs is further divided into M groups of R LP-WUS MOs.   * + - For each group of R LP-WUS MOs, the same LP-WUS information is transmitted.       * FFS how the same LP-WUS information is transmitted in the R LP-WUS MOs     - Different LP-WUS information can be transmitted in different groups of R LP-WUS MOs.     - FFS: detailed UE monitoring behavior   M = 1 and M > 1 is supported.  FFS R=1 or R>=1  Note: this achieves the same purpose as “Option 3: UEs monitoring the same PO are divided into multiple sets of subgroups, with UEs within each set of subgroups monitoring the same LO.” | Wait for further progress |  |
| **Agreement**  For the mapping between LO and PO, supports at least Option 1 (UEs monitoring the same PO monitor the same LO). | Wait for further progress |  |
| **RAN1#119** | | |
| **Agreement**  Confirm the following working assumption with the addition of the note at the bottom:  **Working Assumption**  From RAN1 perspective, for the entry/exit conditions for LP-WUS monitoring in IDLE/inactive mode,   * The UE may start LP-WUS monitoring if   + the serving cell measurement performed by the MR is above entry threshold(s), if configured by the gNB   + FFS other conditions, and if any, whether all or one or some of the conditions need to be satisfied * If UE starts LP-WUS monitoring, it may stop the legacy PO monitoring before UE receives LP-WUS indicating wake-up * The UE monitors the legacy PO (and may monitor PEI) and may stop LP-WUS monitoring if   + the serving cell measurement performed by the LR is below exit threshold(s), if configured by the gNB   + FFS other conditions, and if any, whether all or one or some of the conditions need to be satisfied * FFS the serving cell measurement metrics * The entry/exit thresholds can be configured separately for different types of LR * It is left to RAN2 discussion whether the threshold(s) are always configured by the gNB. * Note: This may be revisited based on the RAN2/RAN4 discussion.   Note: this does not intend to impact any agreements and working assumptions made in RAN1/RAN2 after the working assumption. | Captured in 7.x.0 |  |
| **Agreement**  At least support the case that the number of beams for LP-WUS/LP-SS is the same as the number of SSB beams. | Wait for further progress |  |
| **Working Assumption**  If LP-WUS design support 32 subgroups within one MO, do not support Option 3 for LO to PO mapping or Option B for MO configuration. | Wait for further progress |  |
| **RAN1#120** | | |
| **Agreement**  For the offset value(s) between an LO and a reference PO/PF, at least a frame-level offset is provided.   * The reference point (reference PO/PF) for the frame-level offset is the start of the PF, or the first PF of the PF(s) (if mapping of POs from multiple PFs to one LO is supported), associated with the LO. * FFS other offset value(s) to determine the MOs of the LO | Captured in 7.x.0 |  |
| **Agreement**  For the offset value(s) between an LO and a reference PO/PF, adopt Option 2B-1.   * gNB can configure 1 or 2 offset values.   + FFS whether gNB can configure 3 offset values * If multiple offset values are configured and if the gap between the LO associated with the largest offset value and the corresponding PO is no less than the wake-up delay a UE reports, the UE monitors the LO associated with the smallest offset value that has a gap between the LO and the PO no less than the wake-up delay.   + Note: if a single offset value is configured, UE behaviour is according to Option 1-1. * All the UEs supporting LP-WUS for idle/inactive mode supports the configuration of 2 offset values (FFS: 3 values). | Captured in 7.x.0 |  |
| **Agreement**  Confirm the following working assumption with the modification:  **Working Assumption**  The maximum number of subgroups per PO supported in Rel-19 is 31 | Wait for further progress |  |
| **Agreement**  For the LO to PO mapping from network perspective, support Option 2 (UEs corresponding to different POs monitor the same LO).   * This should not increase the maximum number of codepoints per LO/LP-WUS compared to Option 1. * FFS conditions/restrictions for mapping multiple POs to one LO * Down-select between 2 and 4 for max number of POs per LO. | Wait for further progress |  |
| **RAN1#120bis** | | |
| **Agreement**  Confirm the following working assumption with modifications in red:  **Working Assumption**  ~~If LP-WUS design support 32 subgroups within one MO,~~ do not support Option 3 for LO to PO mapping or Option B for MO configuration.  **Agreement**  Option A for MO configuration is supported.  **Agreement**  A LP-WUS MO can span across multiple slots.   * FFS the limitation on the maximum length for an LP-WUS MO   **Agreement**  Only R = 1 is supported for Option A. | No impact |  |
| **Conclusion**  For the offset value(s) between an LO and a reference PO/PF, do not support the configuration of 3 offset values. | No impact |  |
| **Agreement**  The maximum number of POs per LO is 4, and the number of POs per LO can be 1, 2 or 4. | No impact |  |
| **Agreement**  For Option 2, the maximum value of M (number of LP-WUS MOs per beam) in Option A for MO configuration is 4. | No impact |  |
| **Agreement**  For LP-WUS, the N \* M LP-WUS MOs in an LO are indexed sequentially in time, from 1 to N\*M, where N is the number of beams corresponding to LP-WUS, and M is the number of LP-WUS MOs for each beam.   * The (n\*M+m+1)-th LP-WUS MO corresponds to the (n+1)-th beam, where m=0,1,…,M-1, n=0,1,2,…,N-1. (multiple MOs first, beam second)   Note: Above does not change the previous agreement on association between LP-WUS and SSB beams. | Wait for further progress |  |
| **Agreement**  For OFDM-based LP-WUR, reuse the LP-SS based LP-RSRP/LP-RSRQ definition of OOK-based LP-WUR.  FFS: Whether OFDM receiver can measure LP-SS if overlaid OFDM sequence is not configured (M=1).  **Agreement**  For LP-SSS-RSRP/RSSI measurement performed by OFDM-based LP-WUR for the serving cell, SMTC window is not applicable.  Send an LS to RAN4 to confirm the above agreement. Final LS in R1-2503103.  **Agreement**  LS on the RRM measurement metrics for OFDM-based LP-WUR is agreed. Final LS in R1-2503103.   * Note: RAN1 understanding is existing metrics SS-RSRP and SS-RSRQ are reused for OFDM-based LP-WUR. No separate metrics (LP-SSS-RSRP and LP-SSS-RSRQ) will be introduced in the specifications. | No impact |  |
| **Agreement**  For Option 2, at least one codepoint corresponding to each of the subgroups in each PO is supported.   * For codepoint corresponding to more than one subgroups:   + Alt 2: One codepoint for each PO corresponding to all the subgroups in the PO   **Agreement**  For Option 2, a common codepoint per PO is always used and the maximum number of subgroups supported per PO is   * 7 for the case where 4 POs are mapped to one LO * 15 for the case where 2 POs are mapped to one LO   **Agreement**  Regarding whether there is any restriction on mapping multiple POs to one LO, no additional constraint for mapping multiple POs to one LO | No impact |  |
| **Agreement**  UE determines whether a symbol is available for LP-WUS based on:   * Alt 1: Time-domain pattern configured by the gNB   + Alt 1A: Periodic time-domain pattern     - E.g. (1) 1-slot periodicity, the pattern indicates the available symbols in each slot; (2) multi-slot or frame-level periodicity with a bitmap indication; (3) Search space set-like pattern; (4) multi-level time-domain patterns; (5) reuse the mechanism of rate matching pattern   + Alt 1B: Per-MO pattern, applicable for all Mos * Alt 2: Information from existing configurations available for idle/inactive UEs such as [SSB, CORESET/Type-0 CSS, TDD DL/UL configuration, etc]. * Alt 3: Combination of Alt 1 and Alt 2 * Alt 4: NW ensures LP-WUS configuration without collision with existing signal(s)   **Agreement**  For the determination of starting time locations of LP-WUS MOs and LP-WUS transmissions in a LO,   * A reference point is the start of a reference frame determined by the frame-level offset from the start of the first PF of the PF(s) associated with the LO. * The starting time location of the first LP-WUS MO in a LO is indicated by an offset w.r.t. the reference point.   + FFS slot-level or symbol-level offset * The starting time locations of the subsequent LP-WUS MOs in a LO are determined based one of the following alternatives:   + Alt 1: An offset is indicated for each of the subsequent LP-WUS MOs.     - FFS slot-level or symbol-level offset   + Alt 2: The start time location of a subsequent LP-WUS MO is determined implicitly at least based on the previous LP-WUS MO.     - FFS additional configuration to control the subsequent MO locations, e.g.,       * Alt 2A: configuration of a single gap between the end of the previous MO (or a set of previous MOs) and the start of the next MO       * Alt 2B: configuration of candidate starting locations for MOs, similar to search space configuration   + FFS restriction on MO locations, e.g. only on DL slots   + FFS minimum gap is needed between two MOs to ensure LR processing time | Wait for further progress |  |
| **Agreement**  Terminology definition   * Nominal MO duration: this includes both the available and unavailable symbols * Actual LP-WUS duration: the actual number of OFDM symbols used for LP-WUS transmission as assumed by the UE   Nominal MO duration and actual LP-WUS duration, if defined, are determined using one of the following alternatives:   * Alt A: Nominal MO duration is configured. (e.g. in unit of slots)   + Actual LP-WUS duration is the number of available symbols within the MO.   + Actual LP-WUS duration can vary from one MO to another MO. * Alt B: Actual LP-WUS duration is configured. (e.g. in unit of OFDM symbols, or M and L values)   + From the start of a MO, MO extends until the number of available OFDM symbols reaches the configured actual LP-WUS duration.     - FFS: Additional termination condition such as time window * Alt C: Both nominal MO duration and actual LP-WUS duration are configured.   + If the number of available OFDM symbols within the nominal MO duration is less than the actual LP-WUS duration, the MO is considered as invalid (no LP-WUS monitoring in this MO) and dropped/deferred.     - FFS UE behavior if there is no valid MO for the beam(s) that the UE monitors   + Note: the number of available OFDM symbols within a nominal MO duration can be different for different MOs. * Alt D: Nominal MO duration is configured. The actual LP-WUS duration is determined based on the same pattern for the available symbols for all the MOs (e.g. by using a per-MO pattern), which is the same for all the MOs.   **Agreement**  On how to handle the UE capability report on the wake-up delay for SSB periodicities other than 20ms, consider the following alternatives for possible down-selection in RAN1#121.   * Alt 1: Do not report for SSB periodicities other than 20ms   + Note: LP-WUS is not supported for SSB periodicities larger than 20ms * Alt 2: For UE capability report on the wake-up delay, the UE reports one of the following 3 capabilities (the values in one of the columns):  |  |  |  |  | | --- | --- | --- | --- | | SSB periodicity (ms) | Wake-up delay (ms)  UE capability 1 | Wake-up delay (ms)  UE capability 2 | Wake-up delay (ms)  UE capability 3 | | [5] | [x] | [x] | [x] | | [10] | [x] | [x] | [x] | | 20 | [70] | [500] | [900] | | [40] | [x] | [x] | [x] | | [80] | [x] | [x] | [x] | | [160] | [x] | [x] | [x] |  * Alt 3: It is up to RAN4   **Agreement**  Each LP-SS transmission for each beam always occupies consecutive OFDM symbols. | No impact |  |
| RAN1#121 | | |
| **Agreement**  It can be configured by the gNB in the LP-WUS/LP-SS configuration on whether LP-WUS/LP-SS transmission is present or not for each beam of the actual transmitted SSBs determined according to ssb-PositionsInBurst in SIB1.   * For the LP-WUS MO and LP-SS occasion determination,   + Alt 1: S is the number of actual transmitted SSBs determined according to ssb-PositionsInBurst in SIB1, and LP-WUS MOs and LP-SS occasions are determined assuming S beams. gNB transmits LP-WUS/LP-SS in a subset of the S beams according to the LP-WUS/LP-SS configuration.     - FFS: Additional details on Alt 1 to be finalized in RAN1#121 * If not configured, UE assumes LP-WUS/LP-SS transmission is present for all the actual transmitted SSBs determined according to ssb-PositionsInBurst in SIB1   **Agreement**  Each LP-SS transmission for each beam is contained within one slot.  **Agreement**  For LP-SS, the LP-SS occasions are indexed sequentially in time, and the n-th LP-SS occasion is associated with the beam of the n-th transmitted SSB, n = 1, 2, …, N, where N is the number of actual transmitted SSBs determined according to *ssb-PositionsInBurst* in SIB1.  The RAN1#120bis agreement is updated as follows:  For LP-WUS, the N \* M LP-WUS MOs in an LO are indexed sequentially in time, from 1 to N\*M, where N is the number of actual transmitted SSBs determined according to ssb-PositionsInBurst in SIB1 ~~the number of beams corresponding to LP-WUS~~, and M is the number of LP-WUS MOs for each beam.  The (n\*M+m+1)-th LP-WUS MO corresponds to the (n+1)-th beam, which is associated with the beam of the (n+1)-th transmitted SSB, where m=0,1,…,M-1, n=0,1,2,…,N-1. (multiple MOs first, beam second) | They had already been captured in TS 38.213. And the corresponding FFS in 38304 running CR is removed. |  |
| **Agreement**  For UE capability report on the wake-up delay, the UE reports one of the following 3 capabilities (the values in one of the columns):   |  |  |  |  | | --- | --- | --- | --- | | SSB periodicity (ms) | Wake-up delay (ms)  UE capability 1 | Wake-up delay (ms)  UE capability 2 | Wake-up delay (ms)  UE capability 3 | | 5/10/20 | [70] | [500] | [900] | | 40 | [x] | [x] | [x] | | 80 | [x] | [x] | [x] | | 160 | [x] | [x] | [x] |   **Agreement**  If the number of POs associated with a LO is less than Ns (the number of POs per PF), to determine the LP-WUS MOs for the multiple LOs with the same reference PF:   * Alt 1: additional frame-level offset(s) are configured. * Common slot-level or symbol level offsets are shared across all Los   **Agreement**  For the configuration on whether LP-WUS/LP-SS transmission is present or not for each beam of the actual transmitted SSBs determined according to *ssb-PositionsInBurst* in SIB1:   * use bitmap, with one bit corresponding to each of the SSB beams (similar to existing indication for *ssb-PositionsInBurst*) | No impact. |  |
| **Agreement**  For PO-to-LO association and codepoint determination, assume is the number of POs associated with a LO, is the number of subgroups per PO for LP-WUS, and is the subgroup ID of a UE ().   * The PO index within the LO is defined as   ,   * The reference PF for the LO of a PO is provided by (SFN for PF) – floor(*iPO*/*NS*) \* *T*/*N*, which is the first PF of the PF(s) associated with the LO. * For the codepoints,   + If >1,     - The number of information bits in LP-WUS is .     - Alt 2: (the codepoints for each PO are consecutive)       * The codepoint for subgroup in PO is .       * The codepoint for all the subgroups in PO is (.   + If 1, the number of information bits in LP-WUS is , and the codepoint for PO is . * Here UE\_ID (for LP-WUS), *N*, *NS*, and *T* are defined in TS 38.304 | The agreement of the reference PF is captured in 7.x.0. |  |
| **Agreement**  For UE to determine whether a symbol is available for LP-WUS, at least the following is supported:   * A unit-level bitmap with a periodicity 10, 20, or 40 units and a 14-bit or 28-bit symbol-level bitmap that covers 1 or 2 slots can be configured, where each unit is 1 or 2 slots for 14-bit or 28-bit symbol-level bitmap, respectively, with a maximum periodicity of 40ms.   + ‘1’ in unit-level bitmap means the symbol level bitmap is applied to determine which symbols are unavailable in the unit for LP-WUS (‘0’ means unavailable).   + ‘0’ in unit-level bitmap means: all the symbols in the unit are unavailable for LP-WUS * If the slot-level bitmap is not configured, UE assumes all 1’s for the bitmap. * If the symbol-level bitmap is not configured, UE assumes all 1’s for the bitmap.   **Agreement**  For the handling of SSB for IDLE mode, the SSB symbols are considered as unavailable for LP-WUS, if SSB and LP-WUS overlap in frequency domain  **Agreement**  Nominal MO duration (X1, in unit of OFDM symbols) and actual LP-WUS duration (X2, in unit of OFDM symbols) are configured. (Alt C)   * A LP-WUS MO spans the nominal MO duration (i.e., the LP-WUS MO duration is the same as the nominal MO duration.) * If the number of available OFDM symbols within the nominal MO duration is no less than the actual LP-WUS duration, UE monitors LP-WUS on the first X2 available symbols within the LP-WUS MO. * Otherwise, UE does not monitor LP-WUS in this MO (i.e., the MO is dropped). * Note: Any symbols that are not defined as unavailable are available symbols for LP-WUS.   **Agreement**  The starting time location of the first LP-WUS MO in a LO is configured by an offset w.r.t. the reference point, where the offset is a symbol-level offset  **Agreement**  If LP-SS is configured, the periodicity is configured with the candidate value set of {160ms, 320ms}.   * A time offset is configured for the first LP-SS occasion with reference to SFN0   + If the periodicity is 160ms, the candidate value set for the time offset is {0, 1, …, 159}ms.   + If the periodicity is 320ms, the candidate value set for the time offset is {0, 1, …, 319}ms.   **Agreement**  The number of MOs per beam per LO is configured by gNB, with candidate value set of {1, 2, 3, 4}.  **Agreement**  The candidate value set for the frame-level offset(s) is {8, 9, …, 200} in unit of frames.   * The minimum value can be modified depending on relevant RAN4 outcome   **Agreement**  For UE to determine the LP-SS occasions,   * One or two start symbol locations within a slot are configured.   + Candidate value range for each start symbol location: {0, 1, …, 10}.   + If one value is configured, there is one LP-SS occasion in a slot.   + If two values are configured, there are two LP-SS occasions in a slot. * Starting from the slot for the first LP-SS occasion (determined from the periodicity/offset configuration for LP-SS), LP-SS occasions are present in this slot and the next (ceil(X/Y)-1) DL slots, where X is the number of SSBs determined according to *ssb-PositionsInBurst* in SIB1, and Y is the number of LP-SS occasions in a slot.   + UE expects the slot for the first LP-SS occasion is a DL slot.   + Note: a slot is a DL slot if all the symbols in the slot are indicated as DL symbols in *tdd-UL-DL-ConfigurationCommon*. * Note: UE follows the configured resources for LP-SS processing.   **Agreement**  In one LO, the start time location of a subsequent LP-WUS MO is determined implicitly at least based on the previous LP-WUS MO.   * No additional RRC configuration is provided. * FFS whether/how to ensure a gap between two LP-WUS MOs   **Agreement**  The OFDM symbols configured for Type-0 CSS are considered as unavailable for LP-WUS if CORESET#0 and LP-WUS overlap in frequency domain.  **Agreement**  The UL symbols/slots configured in *tdd-UL-DL-ConfigurationCommon* are considered as unavailable for LP-WUS.  **Agreement**  If LP-SS overlap (including partial overlap) in time domain with the available symbols that may be used for LP-WUS transmission in a LP-WUS MO, UE does not monitor LP-WUS in this MO (i.e., the MO is dropped).  **Agreement**  For the EPRE ratio between LP-WUS/LP-SS and SSB (i.e. LP-WUS/LP-SS EPRE divided by SSB EPRE), separate configurations are provided for LP-WUS and LP-SS.   * The candidate value set for the EPRE ratio is {-3dB, 0 dB, 3 dB, 6 dB}. * If M=1 for both LP-WUS and LP-SS, or M>1 for both LP-WUS and LP-SS, the difference between the two EPRE ratios shall be no larger than 3 dB. * If M=1 for LP-WUS and M>1 for LP-SS, the ERPE ratio for LP-SS minus the EPRE ratio for LP-WUS should be within the range of -6 dB to 0 dB.   Note: EPRE refers to EPRE in one OFDM symbol with non-zero power (from baseband perspective) LP-WUS/LP-SS transmission. | No impact. |  |